PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

MARCH, 1937

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Index for the year 1936 will be sent to subscribers on request.

TIMEWASTERS

Eight Eights:

Bob Clark writes us that traveling around he has found a couple of new timewasters, which he obligingly encloses. The first one:

Use eight "8's" to add up to 1000.

The second one is also short and easy.

With six matches form four triangles having equal sides.

The third one, and, according to him "the best of the lot" is this one:

Form nine dots in three lines, making a square. Then connect all of the dots with four straight lines made without lifting the pencil from the paper.

Thanksgiving in the Future:

Assuming that we retain our present plan of observing Thanksgiving Day on the last Thursday in November of each year, on what day of the month will Thanksgiving fall in the year 2264? *H. A. Blunk.*

Nines and Elevens:

Using all nine digits (1 to 9) in all possible combinations, how many of these combinations are divisible by 11? The gentleman who handed in this one assures us that there is a formula to cover it, but he slipped away in the excitement of a dinner meeting of the ASCE and so we have no recourse but to pass it on to our readers.

Solutions:

A lot of folks got the answer to the Ikey and Mikey pig problem, the price being 5.7 and 6.2 cents, respectively. Fewer got the falling flagpole problem, to which there are two answers (fewer still got the second answer). The answers varied on the flagpole very slightly, but the part that remained standing was about 49.25 feet. We believe, from Mr. Blunk's solution, that it could also break at 11.29 ft. above the ground. This we have not checked. A cubic equation seems to us necessary to solve this, though Mr. Blunk did the first part of his without it, and got 49.5 feet, which is very close.

The dog and fox problem, new variation, was solved by Mr. Blunk and also by Mr. Anderson, they agreeing that a speed of 74.96 miles an hour was necessary. This was a tough problem, and required careful and knowing handling.

The interest of our readers, and their help in keeping this column filled, is greatly appreciated and enjoyed. Thank you.

W. A. H.

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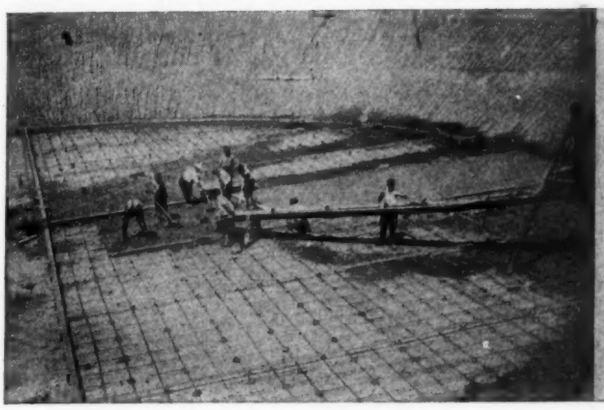
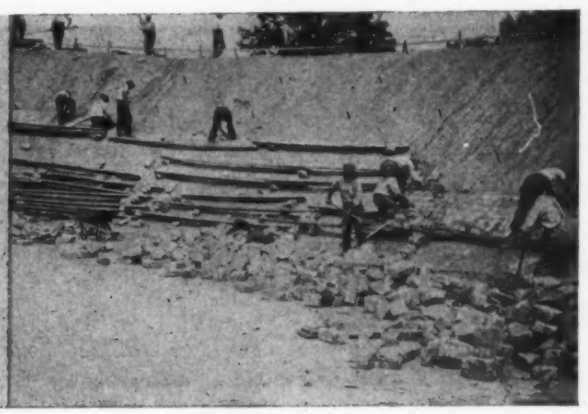


Pouring concrete for bottom



Laying stone block slope lining

North Andover's Additional Reservoir

By WILLIAM B. DUFFY

Superintendent, Board of Public Works, North Andover, Mass.

NORTH ANDOVER, Mass., with a present population of 7,200, started its water system in 1898 when the population was about 4,000. Water was pumped from Lake Cochichewick directly into the system, to which was connected an earthen overflow reservoir of 1,375,000 gallons capacity.

By 1927 the need of additional storage capacity was recognized, and it was urged annually thereafter in the department's reports that the capacity of the reservoir be increased by 500,000, but with no result. By 1934 additional consumption caused the recommendation to be changed to one for a new reservoir; one advantage being that enlarging the old would necessitate running the system by direct pressure 24 hours a day continuously while the work was in progress.

The consumption for the five years 1931-1935 proved the insufficiency of the existing reservoir or even of one 500,000 gallons larger, which would furnish less than two days' storage at the maximum rate of consumption, and only a little over three days' at the daily average rate.

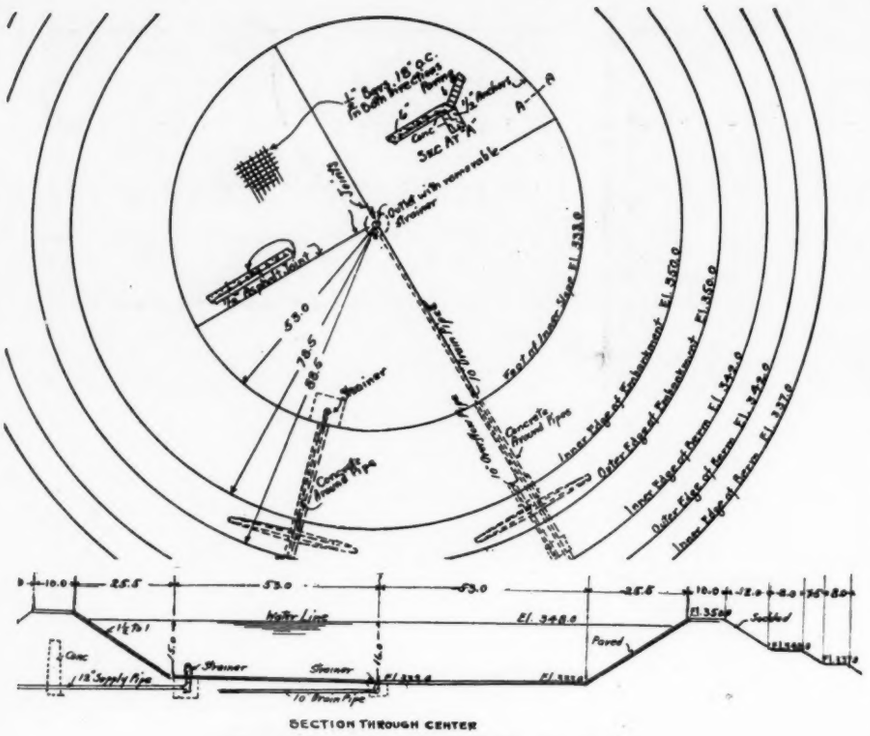
Year	*Greatest Day*	*Greatest Week*	*Year's Consumption*	*Average Daily*
1931	878,000	3,625,000	152,425,000	417,560
1932	900,000	5,033,000	168,746,000	461,000
1933	900,000	4,014,000	158,553,000	434,300
1934	960,000	5,335,000	190,790,000	522,700
1935	1,000,000	5,145,000	205,249,000	567,300

A literal adoption of the recommendations of the National Board of Fire Underwriters would call for a reservoir capacity of 6,575,000 gallons. But in view of the abundant supply available in Lake Cochichewick and the duplicate pumping engines, boilers and accessories, it was decided to provide reservoir capacity of a week's supply at the average daily consumption, or 3,000,000 gallons, or about 1.5 m.g. in addition to the existing reservoir.

It was found that a 1¾ acre site on the hill top adjacent to the old reservoir contained yellow clay hardpan which would provide an excellent bottom and tight embankment, two-thirds of it at about the same elevation as the old reservoir, the remainder sloping to some 20 ft. lower. This site was decided upon, and a reservoir of the same type as the old—circular, partly in excavation and partly in embankment; and aid of the Federal Emergency Relief Administration was secured. A steel tank or concrete reservoir would be more expensive. A covered reservoir has its advantages, but the expense of covering the new one did not seem to be warranted when half the supply would be stored in an uncovered one.

The new reservoir has a bottom diameter of 106 ft., with the center one foot lower than the circumference. Both inside and outside slopes are 1½ horizontal to 1 vertical, with two 8 ft. berms on the latter, and a top width of 10 ft. The bottom is paved with 6″ of reinforced concrete, and the inside slope with granite paving blocks 4 x 6 x 10 in., laid on gravel. The top of the bank and its outside slopes and berms were covered with loam and seeded. The top of the embankment is at El. 350.0, the flow line at 348.0, and the foot of the inside slope at 333.0.

The water enters the reservoir through a 12″ c. i. bell and spigot pipe, a vertical extension of which pierces the bottom concrete near the bottom circumference and ter-



Plan and section of North Andover reservoir

means of an air compressor and two pavement breakers and removed by a hoisting engine and derrick using quarter-yard buckets; the bulldozer still being used for compacting the embankment.

Before the embankment was started the 12″ supply main and 10″ drain pipe had been laid and 6″ of concrete thoroughly tamped all around them under the site of the embankment, and a concrete core wall was built in the center of the embankment to within 5 ft. of the top in the case of the 12″ pipe, and within 2 ft. over the 10″ pipe so that the overflow pipe would pass through it. Special care was exercised in backfilling the pipe trenches and the concrete to prevent leakage.

A ring of concrete was placed around the reservoir bottom at the foot of the slope, just below the level of the concrete floor, with reinforcing rod dowels to tie into the floor slab. The floor was made in four separate quadrants, reinforced with ½″ rods on 18″ centers in both directions, and provision made for asphalt construction joints, which were poured later. Transit-mix concrete was purchased and delivered from the top of the bank by means of chutes; and cured by keeping water-soaked burlap on it.

Next the inner slope was paved with granite blocks, laid on approximately 6″ of very coarse, clean, sharp sand and fine gravel, templates being used to secure the proper slope. A 5 ft. woven wire fence was placed around the reservoir.

Including a quarter-mile of cinder road to the reservoir and a wire fence enclosing the entire town plot, the total cost was $34,270, of which the Federal Government furnished $21,999 for labor and $1,000 for materials, and the town the balance for labor, equipment and materials.

The design and construction were in charge of the writer, while the WPA field engineers, and the county engineer (authorized by State law to supervise construction of all reservoirs over 1 M.G.) made frequent inspections of the project.

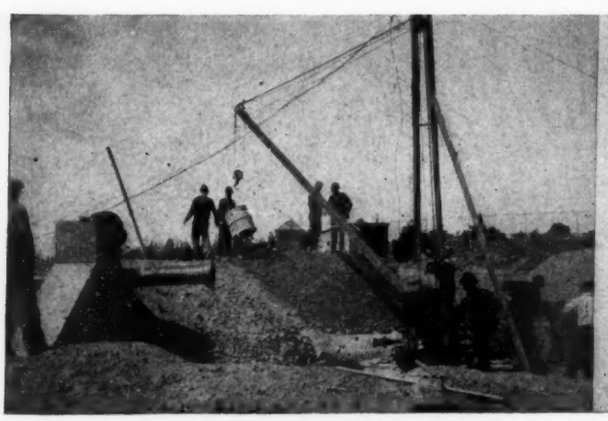
minates in a strainer. Another strainer in the center protects the opening of a 10″ B. & S. drain pipe, a 10″ branch from which rises to El. 348.0 and serves as an overflow, being provided with a valve in a manhole.

Construction

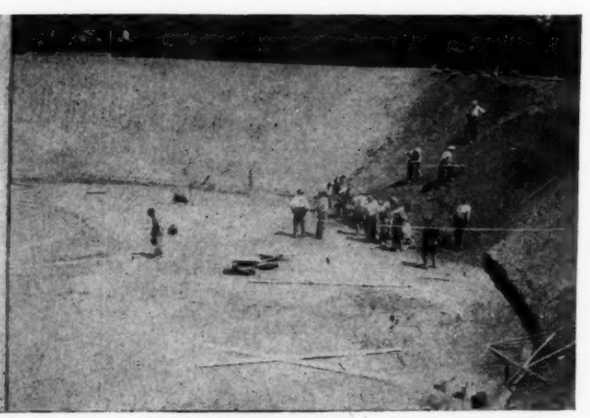
When construction work started, few ERA men were available and these were used for removing fences, brush, trees and stumps. When WPA took over relief matters more men became available.

A gasoline shovel was used to strip the loam and roots from the area to be occupied, all loam being stored for surfacing the embankment. A large bulldozer then plowed and pushed the clay from the excavated bowl onto the embankment, spread it in layers not over 12″ thick, and continued around the embankment to compact it, completely encircling it with each load. As the load was spread, all stones over 4″ were removed. No water was applied, as perfect compaction was obtained without it.

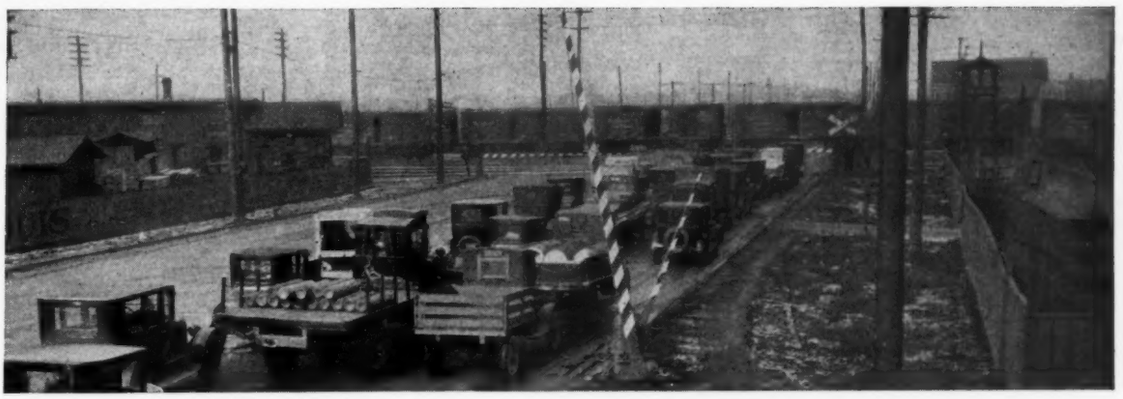
The bulldozer could not excavate to the 1½-1 slope, and when no more soil could be removed advantageously with it, the remaining hardpan was broken up by



Top of cut-off wall, pierced by overflow pipe



Trimming the slope



Delayed traffic in Cook Co., Ill.: Western Avenue near 75th Street before grade separation

The Capacity of Motor Roads*

By B. WEHNER

THE author would emphasize the insufficiency of the available data as a basis for estimating the capacity of highways. Systematic observations have usually been undertaken as a result of serious local overcrowding. Studies carried out in Germany during the last ten years indicate that generally the traffic loads have not approached the full capacity of the roads, and that excessive road wear is attributable to the weight rather than to the volume of traffic. Observations should be based in the first instance on results obtained on a long uninterrupted straight stretch with good visibility throughout. On such roads the limiting load is reached very infrequently.

The vehicle capacity studies carried out mainly in Germany and the U. S. A. (see *Abstracts*, Nos. 429 and 430), usually on a theoretical basis, have been concerned rather with safe following or braking distances than with the actual capacities. SIMPSON has correlated the results of different studies of the vehicle capacity of the single-lane carriageway, the general conclusion being that the maximum capacity (one-way traffic) is reached at about 24 m.p.h., the number of vehicles per hour varying from 1,852 to 2,640 according to the minimum spacing adopted. Practical studies which have been carried out mainly in the U. S. A. show that the prescribed safe spacing is not usually maintained. Observations are taken either from a unit forming part of a traffic stream or from a fixed point beside the carriageway. The first method is simpler but less accurate. LEWIS, in investigations in and near New York, found that the minimum spacing, which corresponded with the reaction time (not braking distance) was only recorded occasionally. WENINGER, working in Germany, came to a similar conclusion.

JOHNSON's investigations showed that the imposition of a suitable speed limit helped to eliminate congestion in crowded areas. His method consisted in co-ordinating the number of vehicles, as recorded by observers stationed along the route, with the number and duration of halts signalled by a number of observers in vehicles proceeding along the route. SIMPSON considered that the absolute capacity of a traffic lane as determined by JOHNSON was too high, since the limiting capacity could be calculated only from the actual time occupied in stops. He suggested that in practice this capacity was reached when drivers began to seek alternative routes. The actual limit, corresponding with the minimum spacing of vehicles, was usually not reached. The maximum capacity also varied according to the duration of the congestion; observations taken in Chicago over short periods recorded a capacity of 3,600 vehicles per hour with a spacing of 32 ft. at a speed of 24 m.p.h., whilst if the congestion continued for an hour the capacity of the lane was approximately halved. In practice, considerations of safety led to a further reduction, the normal value averaging 1,500 vehicles per hour.

EHLGOETZ concluded that the traffic capacity of a lane fully loaded with omnibuses was approximately equal in persons per hour to that of the same lane fully loaded with pedestrians, whilst that of the same lane filled with private cars was less; he inferred that (apart from the value of time) the slower types of traffic were actually the more economical. The calculation of capacity becomes more complex in the case of two or more traffic lanes. JOHANNESON's calculations, based on the time during which the second lane was occupied by vehicles in overtaking, gave a capacity of 440 vehicles per hour at 30 m.p.h. He considered the three-lane carriageway unsafe, preferring the four-lane design.

KELKER's observations on express routes in the U. S. A., show that the addition of a second lane increases the capacity to 1.78 times, of a third to 2.34 times, and of a fourth to 2.60 times that of a single lane. No appreciable increase is obtained by adding a fifth. JOHNSON carried out studies on ordinary roads containing two, three or four lanes, where a considerable amount of weaving was observed. He considered the provision of a third lane desirable from the point of view of capacity, but not from that of safety. The capacity of a two-lane road, based on long-period observations, was estimated at a total of 2,008 vehicles per hour. The load on a three-lane road averaged 2,805 vehicles per hour, the peak load, observed over a five-minute period, being 3,600 vehicles, without perceptible stops. The limiting capacities of four-lane roads,

*Verkehrstechnik, 1936, 17 (16), 413-7; (18), 456-8, as published in "Road Abstracts" of the Department of Scientific and Industrial Research and the Ministry of Transportation (Great Britain).

measured respectively over long and short periods, were 3,496 and 3,912 vehicles per hour. The maximum capacity of a two-lane road was attained when 50 per cent. of the traffic proceeded in each direction; on a three lane road the optimum distribution was 70 : 30 and in a four-lane road 60 : 40. The ratio between the capacities of the two, three and four-lane roads was estimated by JOHNSON as 1 : 2 : 3; the observations of KELKER, based on lanes reserved for one-way traffic, correspond with a relatively lower capacity for four-lane roads.

Influence of Intersections

The formula suggested by EHLGOETZ on theoretical grounds includes expressions representing the normal speed of vehicles, the distance between vehicles, the distance between intersections, the average duration of halts and the time taken in slowing down and starting before and after a halt. JOHNSON has also studied the influence of cross traffic on speeds and vehicle capacity; he found that if the cross traffic amounts to 50 per cent. of the main road traffic the capacity of the main road may be lowered by 40 per cent. JOHANNESON investigated the lowering of road capacity by cross traffic and by vehicles whose drivers were unfamiliar with the road by means of observations of the duration of halts along the route. He considers the time occupied in acceleration and deceleration negligible.

LEWIS, whose work has been amplified by that of NEUMANN, has studied urban traffic in the U. S. A. He develops a formula for calculating the time between two halts, and thence calculates the actual vehicle speeds, from which the road capacity can be deduced. At 20 m.p.h., with signal periods of 120-5-50-5 seconds, the capacity per lane per hour is estimated at 1,150 vehicles; the mixed character of the traffic causes a reduction in practice to about 750 vehicles.

According to LEWIS, a single-lane road without intersections should have a capacity of 1,880 vehicles per hour at 16 m.p.h.; if the signal period is taken into consideration the average speed is reduced to 14 m.p.h. or 11 m.p.h. including the stopping and starting times. The corresponding capacity is 1,020 vehicles per hour. Roads are rarely loaded to full capacity and adequate observation is difficult and expensive. Reference is made to the methods adopted for determining the traffic capacity of a viaduct near New York (*Road Abs.*, 1935-36, No. 710) and the possible application of such methods in estimating the usefulness of bridge and road structures. The Author considers that the elimination of level intersections increases the capacity of a road more than would the provision of additional lanes.

Traffic Entering the Road

Cutting in on the left (English right) is estimated by JOHNSON to cause a 15 per cent. diminution of capacity, and on the right (English left) of 23 per cent.; the reduction can be greatly decreased but probably not entirely eliminated by the provision of additional widening at intersections.

Stationary traffic should be prevented by the provision of adequate verges and parking places; if sufficient ground is not available for the former, parking should be limited to designated areas. LEWIS estimates vehicle capacity per lane per hour under various conditions as follows:—no crossings, through traffic, 1,500; parking permitted, 800; traffic signals at all crossings, 750; at important crossings only, 700; four-lane road and tramway, 600; two-lane road without tramway, 600; tramway at one side of the road, number of traffic lanes not stated, 600; two-lane or three-lane roads with tramway, 475. He suggests that capacity might advantageously be measured in vehicle-miles per hour, as the efficiency of a given road depends not only on the number of vehicles which can be accommodated in a given time, but also on the speeds at which these vehicles can proceed. The increase in capacity as thus calculated becomes less as speeds increase; the respective capacities at 19 and 38 m.p.h. would be 35,625 and 51,835 vehicle-miles per hour.

In the Author's opinion any standard based on vehicle speeds can only be regarded as approximate, and the number of vehicles per unit time should form the basis for all calculations of capacity. In conclusion the Author states that whilst observations of increased accuracy and very considerable scope are urgently needed, road capacity can be increased by certain practical measures, which include improved design, especially with regard to gradient, effective traffic control and careful town planning.

Present Status of Sealing of Abandoned Mines

Work is continuing on the sealing of abandoned coal mines to prevent acid pollution of streams in Ohio, West Virginia, Pennsylvania and Kentucky. We have referred to this work several times during the past three years, since it was started by the advocacy of Surgeon General Hugh S. Cumming. In these four states more than 13,500 abandoned mines have been polluting streams through an unknown number of openings—probably several hundred thousand.

The greatest activity in the mine sealing projects has taken place in Pennsylvania, where work has been carried on in 22 counties. Approximately $1,500,000 has been allotted for the projects, and 1700 men are continuously employed. Latest figures reveal that 208 mines have been completely sealed, while work continues on 139 others. Total closures already made number 30,000. One mine which was draining 800 pounds of acid daily into a stream has had this reduced to 85 pounds. In the case of another mine, a flow of 3,000 pounds of acid a day has been reduced to 200 pounds.

Ohio has 4500 abandoned coal mines in 24 counties, of which 570, with 13,000 openings, have been sealed. B. F. Hatch of the State Board of Health estimates that a daily flow of 3,000,000 pounds of sulphuric acid into the Ohio has been reduced by one-eighth.

West Virginia has located 1368 abandoned mines, of which more than 500 had been sealed by last November, 3600 openings having been closed by about 750 workmen. State Sanitary Engineer E. S. Tisdale estimates that this has reduced the daily acid load from 467,000 pounds of concentrated acid to 102,000, benefiting more than 1,000 miles of streams. This has been to the advantage of water supplies, fishing and recreation; of lock, dams and steel barges, and even the bordering farm lands.

In Kentucky, 633 openings in 110 mines have been closed, and 70 more mines are in process of being sealed, with 4100 more to be attended to. A T. McCormack, State Health Commissioner, estimates that 50,000 pounds of acid a day have been eliminated.

This work has been greatly aided, if not indeed made possible, by funds furnished by P.W.A. Cooperation has been given by the U. S. Public Health Service, U. S. Bureau of Mines, and U. S. Army Corps of Engineers. Allocations for elimination of stream pollution, including mine drainage, have been made to Alabama, Indiana, Maryland and Tennessee also.

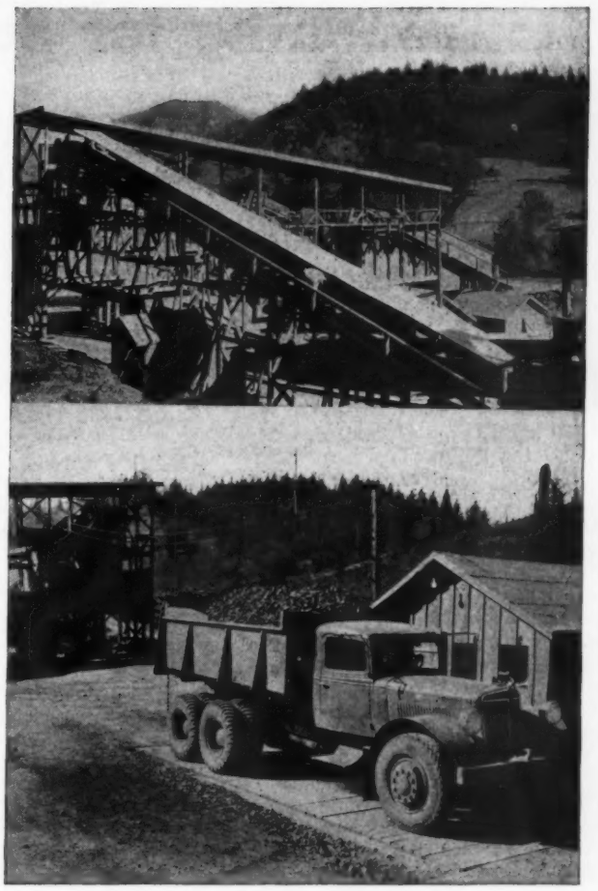
Stage Construction Features of Salmon River Cut-Off

THE Salmon River cut-off project is a notable example of the stage-construction policy advocated by the Bureau of Public Roads, effort being first concentrated on getting through a road quickly and thus securing the benefits from the investment as soon as possible. To accomplish this, economies in initial construction are practiced, structures often are temporary, and surfacing frequently at first is of low type or in certain sections may be entirely omitted.

Thus, when the Salmon River cut-off was proposed, this stage-construction policy was adopted, and the first step, begun in 1927, was to build a graded dirt road of minimum width. The object, of course, was to get the road itself through as quickly as possible. In all the initial construction work, however, final alignments and grades were considered in the plans so that maximum salvage in the future construction stages could be obtained. In subsequent years surfacing and grading contracts were awarded. In September, 1935, the final step in the construction was started, all sections not previously built to ultimate standard were widened and all surface courses were laid over the old surfacing to provide a subbase 17 inches thick of water-bound macadam which is to support a 3½-inch bituminous plant-mix pavement. A contract for this pavement is to be let this coming season.

E. C. Hall of Eugene, Ore., had a contract for reconstruction, resurfacing and stockpiling, between Grand Ronde and Otis, 135 miles, amounting to $240,000. Items covered by this contract were as follows: Fine grading subgrade and shoulders, 13.53 miles; special crushed rock bottom course, 90,000 tons; top course, 20,000 tons; leveling course, 7,000 tons; salvage of surfacing, 3,500 cubic yards; and supplemental crushed rock, 32,500 tons.

The subbase was built up in several layers as follows: First a bottom 6-inch layer of 3-inch rock; second a ¾-inch layer of ¾-inch key rock; third, another 6-inch layer of 3-inch rock; fourth, another layer of ¾-inch key rock; and finally a top layer of ¾-inch rock down to dust. Each layer was rolled, two 10-ton gas rollers being used. The finer layers were processed with water and blade and for this work two 10-foot blades and 2,900-gallon water tank were used. The 3-inch rock was hauled only in the six-wheel trucks and was spread evenly by means of a Jaeger spreader box which was hitched to the rear of each truck when being spread, as shown in accompanying illustrations. Traffic was allowed to proceed over the section with very little inconvenience all the while this construction was in progress.



Top—Rock crushing plant. Bottom—Weighing stone preparatory to spreading

Rock for the subbase was crushed in the plant shown in an accompanying illustration which was located on the project, and rock was obtained from a quarry immediately adjoining. The plant was operated 21 hours a day with three 7-hour shifts. The output was 2,500 tons a day. The plant consisted of a 15- x 38-inch jaw crusher operated by a PD-40 Diesel, an 8-inch gyratory crusher operated by another PD-40 Diesel and the recrusher consisting of a set of 40 by 20-inch rollers which was operated by a 100-horsepower Diesel. A third PD-40 Diesel power unit operated a 50-kilowatt generator, which provided power for driving, by means of individual motors, all conveyors and screens and a compressor, and operating a complete lighting system. All of these Diesel engines were Internationals. Mr. Hall also used 11 motor trucks for hauling stone, of which three were 3½-7-ton 6-wheel, dual-drive, 2-speed rear axle Internationals with 8-yard bodies, and 4 were 1½-ton, 2-speed rear-axle units of the same make with 3-yard bodies.

Spreading stone on Salmon river cut-off

Trenching for Sewer Construction

The following article is from the forthcoming 1937 "Manual of Sewage Disposal Equipment and Sewer Construction"; this year's edition of the Manual being enlarged (at the request of a number of engineers) to include equipment used in sewer construction as well as in sewage treatment. This is in tentative form only. Suggestions are invited as to additional kinds of equipment used in trenching which might be included.

TRENCHING for sewers includes removing the pavement, and the soil, rock and other material under it to a depth usually between 4 and 20 ft.; sheeting the trench when necessary; and removing from it any water that may reach it. Meantime, any water, gas or other conduits, or house connections therewith, that lie in, along or across the trench must be supported and protected from damage; the excavation must be protected by guards, and by lights at night, against traffic, the earth removed must be disposed of temporarily, and provision must often be made for foot and vehicular traffic across the trench as well as parallel to it.

The pipe or other material of which the sewer is to be constructed must then be lowered into the trench and placed in position; the completed structure should be tested for water-tightness, and the trench backfilled (with tamping at least to the top of the sewer) and repaved.

Where the sewer is laid quite deep, part or all of it may be laid in tunnel. Crossings under railway tracks, busy highways or other short stretches are often made by tunnel or by pushing the pipe through from one end.

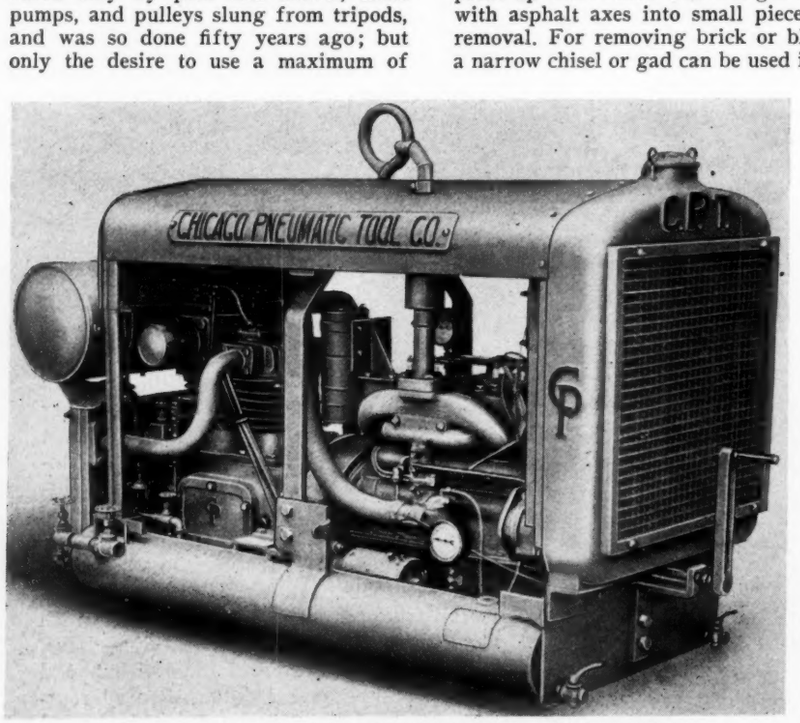
All of this work *can* be done by hand aided only by pick and shovel, hand pumps, and pulleys slung from tripods, and was so done fifty years ago; but only the desire to use a maximum of labor, or very small jobs, can justify neglect to use the labor-saving appliances now available. (An illustration of the out-of-dateness of hand labor was given by a request, in 1934, from a PWA engineer for a copy of a 40-year old edition of "Sewerage" describing the methods then in use, since he could find no one who was familiar with them.)

Removing Pavement

Sewers (except some outfalls) are usually laid in streets; in a few cases under sidewalks, but generally under roadways. In new developments there may be no pavement; but in probably most cases there will be at least a gravel or macadam road, and may be a sheet asphalt, block or concrete pavement. This pavement, if left undisturbed up to the edge of the trench, will help prevent caving and it is therefore desirable to cut through the pavement along (and an inch or two back from) each edge of the trench, ahead of the removal of the pavement. A convenient tool for this is a pavement breaker, using a wide chisel blade for bituminous, macadam or gravel pavement, an asphalt cutter for sheet asphalt, or a moil point for concrete pavement or foundation. The sheet asphalt is then pried up and broken with sledges or cut with asphalt axes into small pieces for removal. For removing brick or blocks, a narrow chisel or gad can be used in the pavement breaker for opening the joints and prying the blocks loose. For breaking the concrete, a point in the breaker is used to make a line of holes, and a sledge or crowbar will do the rest.

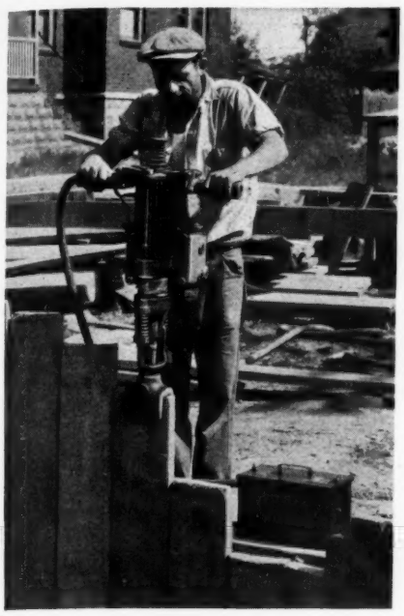
The pavement breaker (an all-round tool for trench work) is usually operated by compressed air or by gasoline. Compressors can be obtained capable of operating one, two or more breakers. Later the breaker can be fitted with a spade for excavating hard clay or hardpan, a point or gad for loosening hard ground or soft rock, a pile-driving saddle for sheet piling, a drill for breaking boulders in the trench, etc.

Pavement breakers are made by: Barco Mfg. Co., a portable gasoline hammer in two weights, 70 lb. and 89 lb., using low-test gasoline, operation cost about 20 cts. an hour. Chicago Pneumatic Tool Co., light demolition tool, weighs 25¼ lb., for loosening soil or cutting asphalt; a general utility tool, weighing 50 lb., for breaking concrete &c. and light drilling; a 75 lb. one, used where air pressure is below 80 lb. The Independent Pneumatic Tool Co.—"Thor" paving breaker, 19¾ lb. (2" stroke) to 81 lb. (4" stroke, 2¾" bore). Sullivan Machinery Co.—"Concrete busters," light (46½ lb.) to heavy (84 lb.). Ingersoll-Rand—four sizes weighing 38, 56, and two at 80 lbs., the two 80 lb. ones being most used for pavement breaking, one delivering a slower, heavier blow than the other.

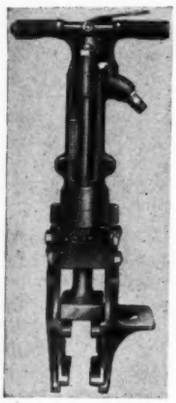


Side view of "utility compressor." Size 71½" x 30" by 50" high.

Pavement breaker, with chisel, spade and point. Cleveland Rock Drill Co.



Barco sheeting driver



Chicago Pneumatic sheeting driver

Worthington furishes pneumatic tools of various weights, from 21 lb. for clay spades to 120 lb. sheeting driver.

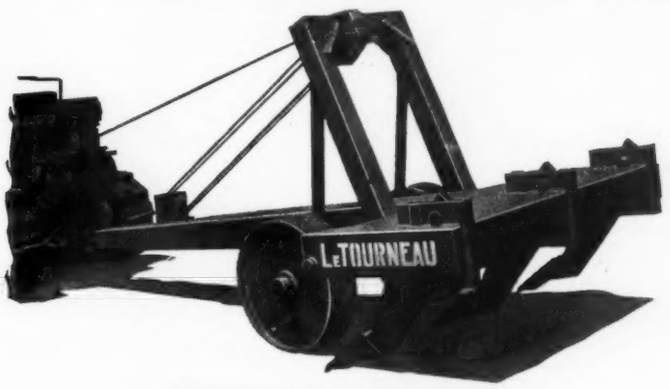
Air Compressors

Portable air compressors are made by The Buhl Co., four sizes, 36 to 330 cu. ft., 2 to 6 compressor cylinders, gasoline driven or motor driven; mounted on steel or solid rubber tires, skids, motor truck or 2-wheel trailer. Chicago Pneumatic Tool Co.—driven by gasoline or diesel engine, two-stage, five sizes, 60 to 315 cu. ft., mountings as above; also a self-contained (can be moved by derrick) 85 cu. ft. "utility" compressor, weight 1,850 lb., can be transported on truck. The O. K. Clutch & Machinery Corp.—single stage gasoline or diesel, 85 to 210 cu. ft. capacity; 2-stage, gasoline or diesel, 160 or 210 cu. ft. Schramm, Inc., 105 cu. ft., weighs 1,740 lb., mounted on skids or 2-wheel trailer. Sullivan Machinery Co.—2-stage, gasoline (Buda) or diesel drive, capacities 105, 160, 210 and 315 cu. ft.; steel, solid or pneumatic tire wheel, skid, or 2-wheel trailer mounting; Ingersoll-Rand — 2-stage, gasoline (Waukesha) or oil drive, capacities 60 to 413 cu. ft.; various mountings as above.

In all the above, capacities are cu. ft. of free air per minute at 100 lb. pressure.

As to capacity needed, Sullivan Machinery Co. states their compressors will drive one concrete buster, clay spader or sheet pile driver with each 35 or 40 cu. ft. of air per min.; a back-fill tamper with about 25 cu. ft., a drill with 75 to 200 cu. ft.

For breaking up gravel, macadam or other pavement with no concrete base, a rooter or scarifier will save time over hand picking. For a narrow trench a bull-nose or rooter plow may be used, or a scarifier drawn by a tractor; for a wide trench a large heavy rooter is useful.

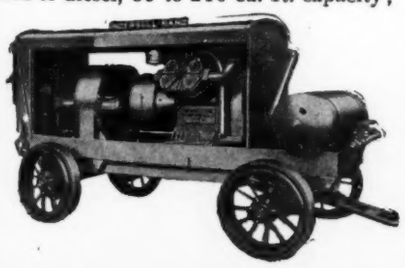


LeTourneau heavy pavement rooter

Excavating Trench

For actual excavation of the trench a number of types of equipment are available, their relative effectiveness and economy depending upon the width and depth of trench, nature of soil, pressure of underground utilities, necessity for sheeting, kind of sewer, speed of sewer laying, conditions of traffic, etc. and of the route of the sewer (whether in busy streets or open fields), amount of ground water, cost and experience of labor, etc. Trenching machines are especially suitable for narrow trenches—say up to 4 ft. width. Clamshells operated from booms of travelling derricks, power shovels and similar equipment can be used for any depth of trench and any width from 4 ft. up, with either sheeted or open sloping sides. The latter (usually practicable only in open fields) permit use of drag scrapers or trench hoes, which are seldom practicable where trench braces and utility pipe cross the trench at short intervals. Where the trench must be sheeted and braced as soon as (if not even before) it is excavated, a means of raising the dirt vertically from it is necessary; although some trenching machines which raise the dirt up an incline carry side shields which serve as sheeting for a few feet back of the boom. The vertical lifting may be done by a clamshell, but the more common method is in buckets filled by hand and raised by a derrick or by an outfit similar to the Moretrench machine.

The dirt so removed is sometimes deposited in a continuous pile along one side of the trench, in others into carts or trucks, and in some cases the buckets are carried directly back and dumped onto the completed sewer.



Left — Ingersoll-Rand electric compressor. Made in 17 to 75 hp.

Left — Sullivan "Truckair" compressor. Capacity 105 cf. m. Most of truck can be utilized for men, tools and materials.

Right — Cut 30 ft. deep in clayey sand excavated with clamshell bucket without sheeting.

Under various conditions almost any kind of earth-moving equipment can be used. One type, called ditchers or trench excavators, is used for this purpose only. These are of two general kinds, one carrying the digging buckets on a wheel, the other on a boom. The wheel type digs to 5½ ft. maximum depth. The "Buckeye" digs a trench 10″ to 22″ wide; the Cleveland, 10½″ to 23½″. About ten buckets are fastened to the rim of a large revolving wheel which is suspended from a boom by which it is lowered to the desired depth. The buckets scoop the dirt from the end of the trench and, reaching the top of their path, discharge it onto a conveyor which carries it to either side and drops it onto a pile or a truck. The traction of the ditcher pulls the buckets against the earth at speeds adjustable from 13.3″ to 416″ a minute in the Buckeye, from 18″ to 156″ in the Cleveland. Overall width of excavator, Buckeye, 52″; Cleveland, 58″.

Parsons trench excavator.

In the boom digger the buckets move down on the outside of a boom, around a sheave at the bottom and up on the inside of the boom; the boom being lowered till its end is at the desired depth; the crawl of the digger forcing the buckets against the earth. At the top, the buckets drop the earth onto a conveyor which discharges it at either side; or, in the Cleveland trencher, at the front end or any point in the half-circle. The Buckeye has cutting widths of 24″ to 40″ (or up to 60″ with side auxiliary cutting attachments), and depths up to 10′ to 15′. For service or other small pipe a Buckeye "service ditcher" digs a 16″ to 42″ trench, depths up to 12′. The Cleveland trenches 21″ to 30″ wide and to 10′ depth. Outside width of Cleveland machine, 58″; of Buckeye excavator, 10′; of Buckeye service ditcher, 7′ 1″.

The Parsons Co. makes ditchers of several capacities. The smallest, No. 14, digs trench 6″ to 12″ wide to a maximum depth of 4′ 6″; has pneumatic tires and a road speed of 6.4 miles per hour. No. 21, 15″ to 42″ (using side cutter), 7′ depth (9′ with boom extension); boom shifts to dig in center or at either side of machine. No. 31, digs 18″ to 36″ trench to 12′ depth; boom telescopic and side shifting, digs within 14″ of curb or other obstruction. No. 40, 24″ to 30″ buckets, 42″ trench with sidecutter, depth to 18 ft. All buckets self-cleaning. Rubber belt conveyor to either side.

A device called a "trench hoe" is offered by several excavator manufacturers. This is essentially a drop-bottom bucket on an arm hinged to the end of a boom and digging toward the excavator, which travels on the line of the trench just ahead of the excavation. By lowering and raising the boom in the trench, swinging the bucket and backing the excavator the bucket is filled; the excavator then swinging to dump it where desired. These are made by Keystone Driller Co., Northwest Engineering Co. and others.

Most of the excavator manufacturers also make drag-line attachments by which a bucket, run out to the end of a long boom lowered into the trench, is dragged back along the trench bottom and up the sloping end of the trench.

Using a clam-shell bucket, or a hand-filled tip or bottom-dump bucket, lowered and raised vertically by the main fall, any excavator or crane can be used for removing dirt from a sheeted trench.

Operating in an entirely different way is the conveying excavator. This consists of a long trestle, spanning and movable along the trench, supporting an overhead rail on which runs a trolley. A bucket, filled by hand in the trench, is raised to the trolley and run back to the completed sewer and dumped on it, the dirt thus being handled but once in both excavating and backfilling, and the street being unobstructed except for a few inches beyond the trench. In the "Moretrench" excavator the standard trestle consists of 8 coupled sections or bents each 36 ft. long, running on a pair of rails 12 to 20 ft. apart. A conveying car is carried on the overhead rail by a pair of trolleys, and this carries an operator and the operating sheaves, which raise the bucket and pull it and the car back and forth by means of a cable. The car also brings the pipe and lowers it to place. Buckets from ½ to 1¼ cu. yd. capacity are said to be handled at the rate of one a minute.

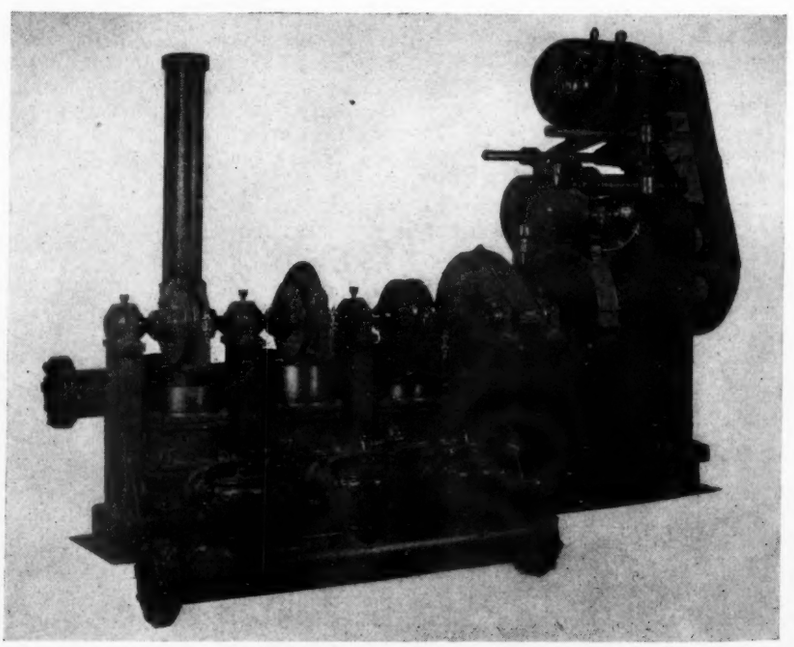
Hand excavating can often be facilitated by use of power-operated spades, points, etc. These are operated by the same equipment as the pavement breakers—usually the lighter sizes. Ingersoll-Rand supply various steels for this service, adapted to clay, hard gravel, frozen ground, for picking, wedging off, trimming clay, etc., and a variety are offered by the Chicago Pneumatic Tool Co., Buhl Co., O. K. Clutch & Machinery Co., Sullivan Machinery Co., etc.

Where there is ledge rock in the trench, drills adapted to light quarry work are used, light charges of explosive if blasting is permissible. If presence of water pipes, etc., necessitates removing rock without blasting, any of the pavement breaking operating heads, light "jack-hammer," etc., can be used to drill holes into which to drive wedges. For this purpose the Atlantic Steel Co. offers a "pneumatic rock breaker."

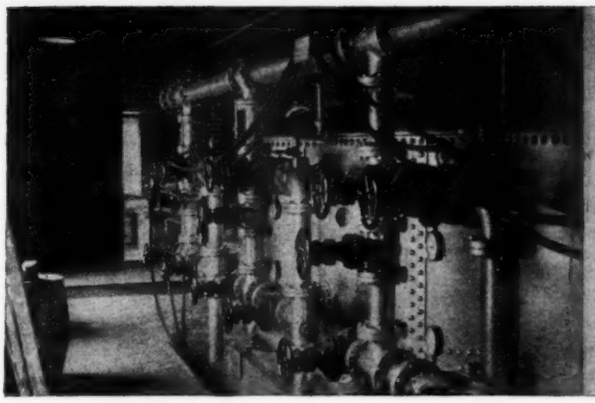
(To be continued)

Large Sludge Pump for Joint Sewage Plant

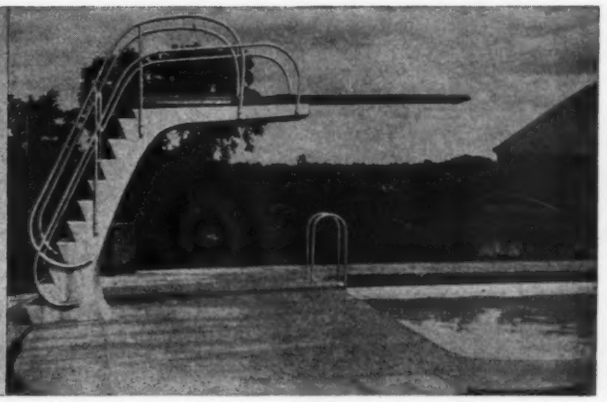
A sewage treatment plant at Elizabeth, N. J., built jointly by a number of communities (Alexander Potter, engineer; J. L. Boyle Engineering Co., contractors), will dispose of the sludge by barging to sea. To fill the 3,000-ton barges rapidly to avoid demurrage, provide for storm delays, etc., an unusually large sludge pump is provided—probably the largest in the country—to handle 2,500 gallons a minute. This is a Marlow pump powered with a 7½ hp. General Electric explosion-proof motor, which is connected to the pump by a Reeves drive, automatically controlled by the level of the sludge in the sludge container.



Sludge pump to handle 2500 gallons per minute



Well-designed group of vertical pressure filters (4 units) with backwash sump



An attractive type of diving platform. Railroad rails were used for reinforcing

Fifty Essentials of Swimming Pool Design

By CHAUNCEY A. HYATT

State Swimming Pool Sanitarium, Illinois Department of Public Health.

(Continued from the February issue)

33. Provide sufficient rewash capacity for cleaning the filters. If filters are to continue to function satisfactorily, they should have a backwash of at least fifteen gallons per square feet per minute. Use at least four filter units (pressure) if the same pump is to be used for both recirculation and backwashing.

34. In outdoor pools where the filters are left in the open and not housed, they should be shaded from the hot sun to prevent the pool water temperatures from exceeding 80°F.

35. Equipment rooms should be well ventilated and should be located where they are easily accessible for getting in chlorine cylinders, barrels, supplies, etc. The floors should pitch at least 5 inches to 10 feet to drains.

36. "Open Court" type bathhouses are particularly advantageous on outdoor pools. They are less expensive and the air and sun help to keep things clean and sweet. Some shade should be provided around the perimeter.

37. Warm water should be provided for showers. The bathers are the source of a major share of the pollution and unless they are properly prepared before admitting them to the pool, the pool operation will suffer. To get them to properly prepare themselves, you must make it easy and pleasant. Cold water showers will not produce the desired result.

38. Toilets to be most effective must be properly located. The spectators should be provided for without allowing them in the bathhouse. "Inside dry" toilets should be located immediately off the dressing area and "inside wet" toilets for persons using the showers or while in a wet condition. "Prison type" closets with no wood and preferably "wall hung" to make possible cleaning the floor easily, are suggested.

39. For handling the bathers' clothes some variation of the so-called "Kansas City" system with baskets, bags, coat hangers or combinations of these. Check rooms should have plenty of ventilation and floors should be pitched to drains (3 inches in 10 feet).

40. Straddle showers at the pool entrance are desirable but should not be depended upon as a substitute for a cleansing shower. Any straddle shower in which the bather while using them is clothed in his bathing suit, is only a "gesture."

41. Liquid soap has many advantages for use in pool installations. Valves should be set to make it possible for the bather to get some results when he attempts to get soap. To prevent waste, standard soap solutions may be diluted several times their volume.

42. Shower controls of the "chain pull" type are unsatisfactory. It is very difficult to take a "one handed" bath. Foot controlled showers have many advantages.

43. Shower room floors should be non-slip and pitch at least 3 inches in 10 feet. Drains may be located to advantage along the wall with the entire floor pitch in a flat plane to the side and a trench or gutter carrying the water sideways to the drain.

44. Sand beaches, if included in a pool installation, should be so located that bathers must shower and pass the same inspection as upon entering the pool area for the first time. This will necessitate a proper barrier and one-way baffle gates to permit handling with a minimum of personnel.

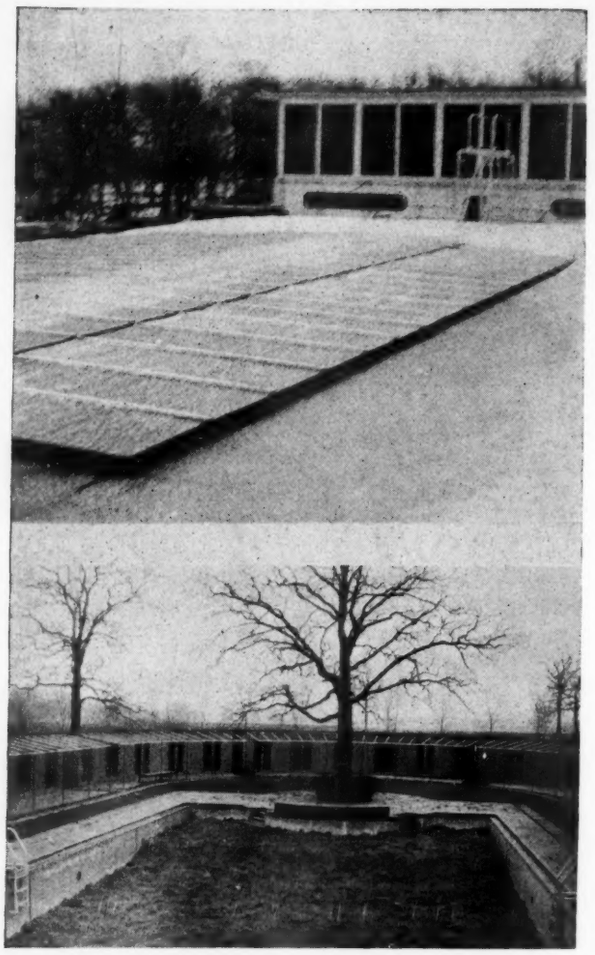
45. No pool should be built without proper and adequate subsurface drainage to carry off accumulations of water that may freeze and heave the pool floor during cold weather.

46. Diving equipment should be standard as to heights, etc. Sufficient depth should be provided and enough area of deep water included to prevent accidents. Permanent diving platforms should not be permitted with a height of over ten meters in a public pool.

In general, a one-meter springboard requires a minimum depth of 8 feet and requires an area of water of proper depth of approximately 700 square feet (20′ x 35′). A 3-meter springboard requires a minimum depth of 9½ feet at the deepest point and an area of approximately 1,000 sq. ft. (25′ x 40′). These are minimum depths; a margin of 1½ ft. over these depths is recommended whenever possible, to give maximum safety.

47. Built-in suction cleaners should be included. The standard hose length usually furnished is 50 feet, and only sufficient wall connections should be provided to cover the pool bottom with a minimum of overlapping.

48. In outdoor pool installations, temperature regulation during the major portion of the season usually consists in an attempt to keep the pool temperature be-



Top—This all-tile-lined pool is protected during off season by a roof covering the entire structure
Bottom—Pool bottom covered with marsh grass—unnecessary if proper subsurface drainage had been provided

low 80°. When the water supply temperature approaches this point it becomes increasingly difficult to control temperature by the addition of make-up water and some other provision may be required, such as a heat exchanger in which an undesirable water of lower temperature may be used for reducing the pool temperature without any mixing. Sprays also are used for this purpose.

49. Ample provision to take care of backwash water must be provided. In backwashing filters, a large quantity of water (15 gallons per sq. ft. per minute of filter area) must be disposed of without flooding the equipment room and also in a manner which will prevent any surcharge from connecting sewers.

A wash sump (broken connection) represents a satisfactory solution, but when used must have ample capacity to develop head sufficient to prevent flooding.

50. Off-season protection in outdoor pools, which is required during a major portion of the year, is important. All pipes must pitch to low points and be provided with drains or cleanout plugs.

Equipment such as motors, removable parts of disinfection apparatus, etc., which may be exposed to possible flooding due to high water, failure of sump pumps, etc., should be removed or elevated to such a point that they will be protected.

Pools with tile overflows should in most cases have these parts covered to keep water from damaging them by freezing and thawing.

If a pool has satisfactory subsurface drainage, little need should develop of filling it with straw, cornstalks, hay, etc. during the winter season. "Open court" type of bathhouses have a very decided "off season" advantage because they have no windows to protect from vandals.

Plenty of room should be provided for the storage and protection of portable equipment during off-season.

Making Street Markers

Arthur E. J. Johnson, City Engineer
Red Oak, Iowa

Under WPA, we made an improvement that met with much favor; this was reinforced concrete street marker posts, that look like miniature Washington monuments; two of these to each intersection; posts are 10 ft. long, 7 in. square at base, and 5 in. square at top, set 3½ ft. in the ground at opposite sides of intersection. Each post painted with aluminum 42 in. down from the top, with black letters up and down on posts; four ⅜ in. rods reinforce each post, tied at 5 points with No. 9 wire loops.

I did not realize how many people were interested in street markers until they were set. Many people are lost as to street names as soon as they are three blocks from home, and are glad to become acquainted with all parts of town. "Know your home town" is not a bad thing and the posts help.

One of Red Oak's street markers

They make a good winter project, as they do not require much space to construct inside a heated room. We had two sets of forms, each making 10 posts. By using high early strength cement, or 2 pounds of calcium chloride per sack of cement, we could change forms each day. Top caps were of sheet metal; balance of form of 2 x 8 lumber sawed to shape with 3-cornered strips to form bevels at corners.

I will send details to anyone interested.

The Editor's Page

Cities Improve Their Financial Condition

Municipal bond prices have reflected the steady improvement in the financial condition of most of our cities. True, a few of the larger cities, and small groups of municipalities in certain states, remain in difficulty; and doubtless the publicity from these has obscured the condition of the great majority of governmental units.

A recent survey of 146 cities by Dunn & Bradstreet, Inc., indicates an extensive improvement for the third successive year in tax collections. In 1930, the average tax delinquency was slightly over 10%. In 1936, it was 13.9%, as against 26.35% in 1933. This, of course, refers to property taxes only; these are the chief reliance of local governments for operation, but are not the sole source of income.

During this same period, the debt of cities and of counties has been reduced. There are, so far as we know, no complete figures covering these data for late years; but reports from many states have been pieced together, and the figures indicate that while debt reduction has been going on, fewer new debts have been created. A fair estimate of the total debt reduction might be around 10%.

Floating debts were, in many cases, high six or seven years ago, but county and municipal officials did not worry unduly about them. These have generally been markedly reduced, but again figures are absent for any large proportion of the cities and counties.

Ultimate losses on delinquent taxes are small. The survey mentioned above states that of the 26.35% of taxes which remained uncollected at the end of 1933, only 4.4% remained to be collected at the end of 1936.

Laboratory Experiments vs. Plant Experience

Scarcely a meeting of an engineering society occurs without the presentation of one or more papers describing the results of carefully controlled laboratory experiments on the uses of various new materials or equipment; or of new uses for already well-known materials and equipment.

The precise knowledge gained by such painstaking work is, in the end, valuable in so far as the knowledge thus gained can be applied to actual plant work. But there is a great danger that the results of laboratory work will be taken too literally. We mean by this that, in sewage work especially, plant conditions practically never simulate laboratory conditions, and results reported on the basis of laboratory work may discourage the use of methods, equipment or materials that are actually effective in plant operation.

More and more engineers realize that the variations in sewage—from plant to plant, and from hour to hour in the same plant—are important, and must be taken into account in the application of treatment measures. Another exceedingly important point is that very many of the smaller plants are not, and never will be, operated at topnotch efficiency. Unheated sludge digestion tanks, uncontrolled or only partly controlled acidity, local sewage constituents, and many other factors enter into this. It may be a laudable ambition to make each and every plant a model of design and of operation; but in the meantime, the problem is one of getting best results with the equipment and plant already installed.

Laboratory experiments that are not backed by a broad experience in operation, or by other similar extensive knowledge, should be regarded as only one of many factors to be considered. Even then, unless these experiments cover a large field of research, their value should be discounted.

We do not believe that even the most carefully planned and carried out laboratory experiments can determine exactly (especially for the small plant) what results will be attained through plant-scale operation. This is especially the case with chemical treatment. We believe that in designing a plant where chemical treatment is to be used, agitating and mixing apparatus, settling tanks, etc., can be planned beforehand with reasonable success, but that the selection of the chemical and the devices for feeding and handling it should be based on plant-scale experiments.

In the average smaller plant, where highly-skilled operators are not in control, with all of the latest desirable devices for turning out an effluent free from suspended matter, BOD, and all the other odds and ends of flotsam and jetsam that congregate toward a sewage treatment plant, things do not often simulate laboratory conditions. That should be borne in mind when poring over reports of such tests.

That Gas Tax Diversion Problem

It is refreshing to note that Congress is again waking up to the problem of gas tax diversion, and seems on the point of taking some definite steps to withhold Federal Aid Funds from those states that continue to divert their highway funds.

If diversion is for the purpose of using these funds for employment, diversion is pointless, because highway construction fills that need. If diversion is for the purpose of making this country a better place to live in, adequate highway construction meets that need. The list could be continued indefinitely, but the net result remains the same. Taxes collected from motorists should be spent for highway construction and maintenance and cannot be spent more profitably for any other purposes.

Pipe Friction in a New Waterworks System

By ROBERT NEWTON CLARK

A COMPLETE new waterworks system was installed during the summer of 1936 at Creston, Ohio, a village of about 1100 population, located thirty-three miles southeast of Cleveland, Ohio. From observations made when the system was ready for operation, it appeared that the pumping heads under actual service were somewhat lower than originally estimated, and accordingly a series of tests were made to determine as accurately as possible the pipe friction losses in the distribution system. The results of this study as presented here are of particular interest, first as an estimate of pipe friction under the conditions described, and second as a method of analyzing the distribution of flow through a branching network of pipes.

Description of Waterworks System

The general layout of the Creston system is shown in Figure 1. The elevated steel tank is of 100,000 gallons capacity, with a difference in elevation of 127.5 feet between the gauge in the pump house and the overflow. Water is obtained from a 10-inch driven well, 122 feet deep and has the following partial analysis:

Alkalinity	210 p.p.m.
Incrustants	0 p.p.m.
Alkali Carbonates	53 p.p.m.
Total Hardness	157 p.p.m.
Iron	0.8 p.p.m.

The characteristics of this water render it suitable for introduction directly into the system without treatment. A single lift, ten-stage, 8-inch Deming deep well turbine pump, is used to deliver water to the distribution system. The pump is driven by a 20 horse-power U. S. electric motor, and in an emergency an auxiliary 26 horse-power Hercules gasoline engine, operating through a Johnson geared head, will provide standby power. All water pumped into the system is measured by a 6-inch Venturi meter equipped with an indicating and recording register, made by the Builders Iron Foundry. Operation is controlled automatically by an E. C. & M. Co. pressure governor, which starts and stops the electrically driven pump according to variations in system pressures.

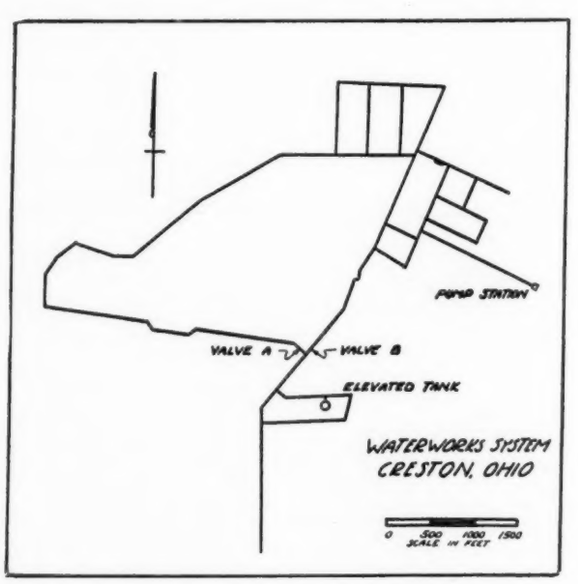


Fig. 1—General plan of distribution system

Description of Pipe

The distribution system consists of 918 feet of 8-inch, 13,705 feet of 6-inch, and 16,170 feet of 4-inch cast iron pipe. The lines are of Class 150 Mono-Cast, centrifugal bell and spigot pipe made by the American Cast Iron Pipe Company, except for certain railroad crossings where Class 250 Doublex-Simplex pipe was used, encased in corrugated culverts.

The inside coating of coal tar pitch varnish is smooth and glassy in appearance, and without doubt this coating is responsible for the low friction losses in the pipe as laid. Joints are made up with square braided hemp and "Tegul-Mineralead" and are well constructed and smooth. The general quality of workmanship is illustrated by a test, before the system was put in service, which showed leakage for the entire system at maximum pressure to be 21.5 gallons per inch mile per day, a very reasonable figure.

Field Observations

The first step in the determination of pipe friction was the securing of experimental data to determine pumping heads and flows. Three runs were made, first with all valves in the system wide open, second with valve "A" closed, shutting off all flow through the western 4-inch loop, and third, with valve "B" closed, diverting all flow through the western 4-inch loop. At the pump station observations were made of residual and pumping pressures, and of discharge under each condition. Runs were long enough to insure that steady flows and steady pressures prevailed, and while surges were noted, the method of conducting the tests eliminates them from consideration in this study. The instruments used in the test were new, factory calibrated, newly adjusted, and believed to be accurate. Before the test, the pressure gauge was checked against the measured height of the tank and the residual pressure recorded was found to be accurate. With due allowance for an increase in the tank water level during the test period, the following pumping heads and flows were observed at the pumping station.

Case 1—All valves open—Head 16.0 ft.—Flow 248 g.p.m.
Case 2—Valve "A" closed—Head 16.5 ft.—Flow 245 g.p.m.
Case 3—Valve "B" closed—Head 70.0 ft.—Flow 132 g.p.m.

For the purpose of analysis, it is assumed that all water pumped passed directly to the elevated tank, neglecting the quantity being drawn from the system by consumers. Inasmuch as the pumping heads are computed as increments above residual pressures, the small differences due to domestic drafts are largely compensated for, and the assumption is believed to be within practical limits of accuracy.

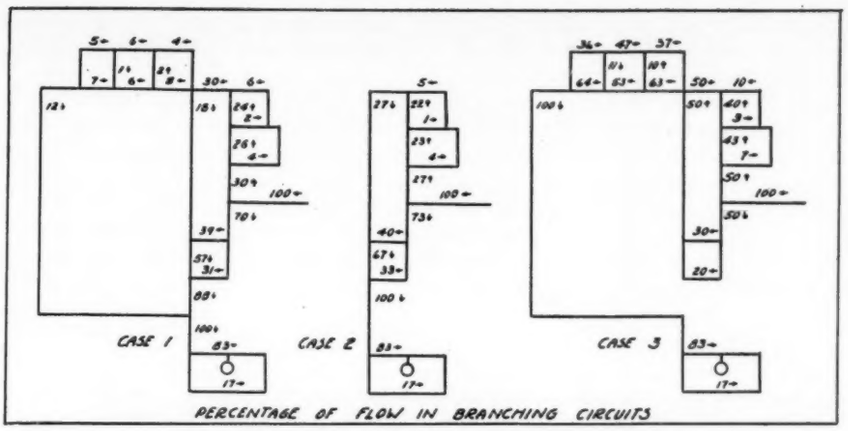


Fig. 3—Distribution of flow for each of the three cases

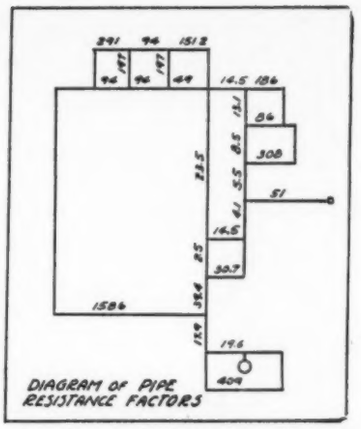


Fig. 2 — Conventionalized diagram showing computed values

Flow Analysis

The second step was the analysis of flow distribution in the system. To accomplish this, the method proposed by Professor Hardy Cross, in Bulletin No. 286 of the Engineering Experiment Station, University of Illinois, entitled "Analysis of Flow in Networks of Conduits or Conductors" was followed. This method is based upon Williams and Hazen's formula, which in a modified form can be written $r \times 10^{-5} \times Q^{1.85} = h$.

Where Q=discharge in gallons per minute
h=friction loss in feet of head
r=resistance factor per 1000 ft. of pipe

The value of "r" is independent of flow, and depends only upon two variables, the discharge coefficient "C" of Williams and Hazen, and the diameter of the pipe. Inasmuch as the value of "C" is unknown, the true value of "r" cannot be derived directly. If a single pipe were being considered, "r" and "C" could be found by a simple solution of the equation given by substituting observed values of head and flow, but in a branching system, some method must be considered for balancing flows in different circuits, and a direct solution is not possible.

The general attack on the problem is relatively simple. First, an assumption is made of the total flow (Q) through the system, and of the discharge coefficient (C). Second, on the basis of these assumptions, the value of "r" is derived for the system as a whole, considering branching flows and the relative friction in each line and in effect replacing the network with a hypothetical single pipe. Third, the observed loss of head is substituted in the basic formula, and the discharge computed from the assumed "C". Fourth, the true discharge coefficient is computed from the ratio between the observed discharge and that calculated by using the assumed "C".

The first step, the assumption of "Q" and "C" is taken in accordance with Doland's application of the Cross theory. "C" is assumed as 100, and "Q" as 100 g.p.m. These figures lend themselves readily to numerical computation, and results obtained are in the form of percentages.

The second step, the derivation of "r" for a hypothetical single pipe having the same hydraulic characteristics as the network, is possible by the strict application of the Cross theory. The value of "r" for each line is determined from the following table, based on C=100.

Diameter		r per 1000 ft.
4-in.	—	246.
6-in.	—	34.1
8-in.	—	8.4

The computed values are shown in Figure 2, a conventionalized diagram of the system. Flows are balanced through each circuit by successive correction until all hydraulic requirements are fulfilled, and the loss of head determined between the pump station and the elevated steel tank. The distribution of flow for each case is shown in Figure 3. Substituting in the basic formula the value Q=100 and the computed head loss for each of the three flow conditions, three values of "r" are found as follows:

Case 1, Q=100, h= 5.98, r= 120
Case 2, Q=100, h= 6.42, r= 128
Case 3, Q=100, h=88.46, r=1770

These values of "r" represent the resistance factors to be expected in single straight pipes having the same hydraulic properties as the networks when C=100.

The third step is to substitute the observed loss of head in the basic formula, using the three values of "r" just given. The flows (Q) computed by using these values would represent the discharge from the system if the discharge coefficient (C) of the pipe were 100. These quantities are as follows:

Case 1 — h—16.0 Q_{100}=169.5
Case 2 — h=16.5 Q_{100}=167.0
Case 3 — h=70.0 Q_{100}= 87.9

Friction Factors

The ratio of actual observed discharge to the theoretical discharge with C=100, expressed as percentage, represents the actual value of "C" under the observed conditions, and the fourth and final step is this computation. The values are as follows:

Case 1 — Q_{100}=169.5 — Q=248 — C=146
Case 2 — Q_{100}=167.0 — Q=245 — C=147
Case 3 — Q_{100}= 87.9 — Q=132 — C=150

The difference between the three values of "C" may be due either to observational errors, or to the fact that the ratio of losses in straight pipes to losses in bends and branches varies in each case, or it may be that redistribution of flow emphasizes variations in pipe friction under different conditions. It is felt that the agreement is reasonably close, and is a fair representation of the actual condition of the system. It may be mentioned that these values are very high, showing a capacity for the system in excess of that to be expected from very smooth and straight brass pipe, and the results are particularly impressive because they are representative of pipe as laid, rather than of pipe under test conditions.

The benefit of this study will be increased by future observations, under similar conditions, to check on deterioration in the hydraulic capacity of the system. However, it is very interesting to know what results can be secured in the way of reducing friction losses in new pipe by modern methods of manufacture and coating. The greatest good in this study is to be found in the method of analysis, which illustrates a simple, accurate, and rapid means of computing flows in a branching system, a job which has always seemed difficult and tedious. By means of this analysis, estimates and personal judgment can be improved and extended, and it should prove to be a useful tool in hydraulic computations.

The Creston waterworks system was constructed by H. W. Baker, General Contractor, Wharton, Ohio, under the supervision of Floyd G. Browne, Consulting Engineer, and the present study was undertaken with the cooperation of H. A. Stebbins, president of the Creston Board of Public Affairs, Warren Knepp, plant operator, and Roger W. Loveless, resident engineer.

Present Status of Incineration of Municipal Refuse*

THERE appears to be more interest today in the construction of incinerators than there has been for some time; although it is probable that if no further financial aid were to be given by the Federal Government, many of the contemplated projects would be postponed.

During recent years more consideration than formerly has been given to the structural details of furnace design, with the result that maintenance has been reduced and the life of furnaces has been increased. The design of refuse furnaces has approached more closely that of boiler furnaces and, as sound mechanical engineering details have been emphasized, the design of the plant has improved.

Substantial reductions have been made, not only in the amount of hand labor required in operation, but also in eliminating some of the more objectionable phases of hand labor. Probably the greatest improvement in this direction has been made in charging facilities. Formerly most plants were charged by hand, while now most large plants are crane-fired, as are also many of the small ones. On the other hand, in localities where labor is always cheap and plentiful, some large plants have been designed for hand charging, but the design of plant in such cases has occasionally been such that the operations of dumping and charging are segregated, with an increase in safety and comfort of the charging men and a minimizing of the disagreeableness of the task of handling raw garbage. A recent development in charging equipment is the use of electric gear motors and clutches in place of air rams.

Labor has also been reduced and working conditions have been improved in the handling of the ashes. Until a few years ago ashes were customarily raked from the grates directly onto the stoking floor. Clouds of hot dust and disagreeable smoke filled the stoking room on such occasions. Frequently the ashes were quenched on the floor, by spraying water over them with a garden hose, with consequent clouds of steam. An attempt was made to improve this condition by providing large ventilating hoods, connected with the forced-draft fans, across the front of the furnaces. Later, dumping grates were provided by means of which the ashes were dropped into ash pits below the stoking floor, for subsequent removal into wheelbarrows or cars in an ash tunnel or basement. While this reduced the arduous labor in the stoking room and improved the working conditions there, it merely transferred the disagreeable working conditions from an otherwise well-ventilated stoking room to what was generally an ill-ventilated basement.

The next improvement came in providing quenchers in each ash pit, for either continual or intermittent use; with water-sealed gates, which permitted reasonably high forced draft without blowing smoke into the ash tunnel. With the water-sealed gates, provision has been made for operating the gates either by oil rams or by hand-ratchet wrenches in the smaller plants. Substitution of electric motor-operated ash trucks running in the tunnel from the pits to a skip hoist reduced the labor required in the ash tunnel and increased the rate at which ashes could be handled through the plant. Frequently this is now accomplished by driving motor trucks directly through the ash tunnel and loading them as they pass each ash pit by merely opening the ash gate and letting the ashes fall from the pits above into the truck, thus saving the rehandling operations otherwise required.

In plants burning very dusty fuel, such as mixed refuse or rubbish with a large percentage of household ashes, consideration is being given to the elimination of the dust caused by handling the refuse in the receiving bin. In order to secure the storage volume required, it frequently is necessary to provide deep bins, and as the refuse falls through a great distance, clouds of dust rise to the charging floor. Provision is being made in designs by the Department of Sanitation in New York City, and elsewhere, for capturing this dust at the top of the bin wall. Controlling this dust, however, is not a simple matter where the length of bin is great and the space through which the material is dumped is high. This is one feature of plant design which deserves careful study.

For a number of years records of combustion-chamber temperature have been kept in many plants, although frequently no use is made of these records, even in controlling the temperature of the fires, because it is so simple to tell without instruments the temperaure which is being maintained. Recently automatic temperature control has been installed, in addition to the indicating and recording equipment in a few plants, as at Washington, D. C., and Newton, Mass. In the plants mentioned, this has been obtained by controlling the admission of secondary air. In the new Rochester plant provision is being made for automatic control of the main dampers as well.

(Continued on page 28)

* From a report of the Committee on Technical Aspects of Refuse Disposal, Sanitary Engineering Division, Am. Soc. of Civil Engineers.

Practical Kinks for the Engineer

Contributions to this page are invited. Send in your kinks. Public Works will pay $3 each for those published.

Tappet Spring Prevents Taking Grease Cups From Machinery:

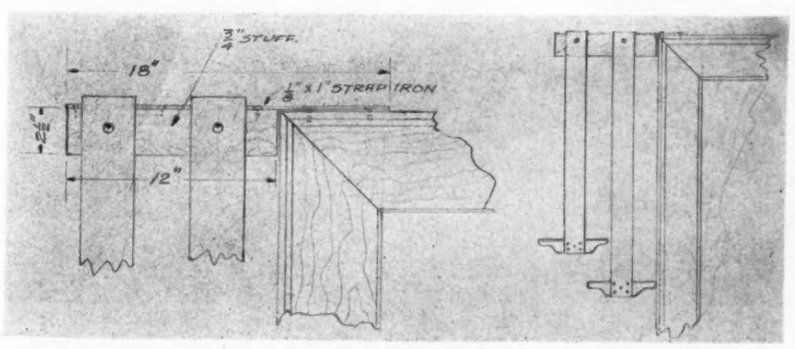
Grease cups are often removed from temporarily unused construction machinery, being taken at times when one may be in something of a hurry, but not inclined to go to the trouble to get needed cups from other proper sources. The small trimo or even a pair of pliers can of course remove them readily. A method to prevent this is shown herewith. Cut off a short length of an old spring, old tappet valve springs are satisfactory for the usual small cups. Put the lower or stud part of the cup snugly in the threads over the bearing with a light square drift tapped into the hole thru the stud. Cut the spring off so it will compress snugly when the stud is tight. With this in place a wrench or pliers cannot be used to grip the hex on the stud, and the spring will simply turn around. The usual pilferer does not have a proper square drift, and as a result will let the cup alone. The spring also acts as a lock to keep the cup stud from working loose.

★ ★ ★

Wing Nuts Used on Homemade "T" Square Blade Holder:

Various devices are made to hold snugly the blade of the smaller drawing board "T" squares in line with the board and to keep the head firmly against the left edge. Most of these homemade arrangements consist simply of two pieces, one on each side of the blade, the lower piece having a spring or tension piece to ride the right edge of the board. Small wing or thumb nuts to afford a quick convenient adjustment of the tension are difficult to procure or make when putting together one of these handy homemade attachments. However the light wing nuts from two of the common inexpensive auto license fasteners meet specifications to an exact nicety. They are just large enough and just small enough to easily manipulate with the fingers, and take a 3/16" screw which is readily procured in any length to suit the width of the pieces used around the blade.

Fixing it so the Borrow Brothers can't get away with grease cups



When the landlord won't let you drive nails into the wall, here's how to hang up your T-squares and triangles

Above is shown how wing nuts are used on a home made T-square blade holder.

Below is a kink for attaching a warning flag so it won't come off

Picture Frame Device for Attaching Warning Flag:

Material, supplies and other things are often loaded on the truck or car and extend well beyond the back end of the vehicle. A red or warning flag must, of course, be fastened in some manner to the end of such projections. A shiftless method is of course to knot the flag in any manner and in any place it can be done. Procure a number of common inexpensive small picture cleats and clinch two of them, one in each opposite corner of the flag as shown. They afford a quick convenient means of readily attaching the flag to pipe, ladders, rods and about anything else which creates this necessity about the truck. The small cleats do not harm the material of such flags and are not in the way when the flag is folded and put away in the tool box.

★ ★ ★

Handy Rack for Holding "T" Squares:

In many rooms or places it is impossible to locate a convenient place to hang "T" squares. Screws, nails or hooks are in many cases forbidden by building managements. A simple, but very practical arrangement or scheme is shown herewith, by which the hook block was suspended from a convenient door casing. The ¾" piece of wood was fastened by small screws to the top of the door casing. The inside edge of the block was braced or held against the top of the side casing board or strip. The casing in this manner was in no way marred or disfigured, and it afforded a handy means of conveniently keeping a number of "T" squares.

Roadside Development for Counties–IV

Organization, Planning and Cost of Roadside Improvement

By F. M. GUIREY

Landscape Engineer, Arizona State Highway Department

THE organization of a department or division of county roadside improvement in the county highway department may be broken down into several general classifications. First, maintenance of right of way; second, maintenance of trees; third, planting of trees and new growth.

The first classification is possibly the easiest of the three to work out. It involves no additional labor, except in mountainous country, where deep cuts require hand work, and the maintenance men now working can take over and do it along with their regular shoulder work. The first thing that is necessary is to show them that they are not going into the field of "pansy planting," but doing an old job in a new way that will help to promote safety, and in the long run lessen their own work. Your own State landscape engineer or achitect probably has work in which elementary backsloping, borrow-pit filling and side ditch elimination are involved, either in or near your county highway headquarters town. A single picture is worth many words, and a look into the actual work on the ground can do more real good than lectures you could give and books they would read. The main points to remember are to stop gouging, stop blading the right of way barren, and at all times, when working with power equipment, take care to develop natural ground contours rather than ragged, hacked areas that look like battle fields. Also take care when burning brush or debris to keep the fires far enough from the growth to be saved to prevent scorching it.

Maintenance of Growth

Now with regard to the actual preservation and maintenance of growth. It is a good idea to have one man in your department specifically delegated to this work, even if he is able to devote only a part of his time to it. If you have an experienced forester to call upon, you are just that much to the good. Above all, this man should be one who has a real interest in the work rather than someone who just happens to be a friend of a friend or what have you. Unless he is really willing to put an honest effort into his plant work, the results will in all probability be very sour.

If you do not have a trained man available, take one who is intelligent and willing to learn, and start him in on the easiest things first. Light trimming, selective thinning—not removal of trees, removal of dead wood, and the like. Get some forestry manuals from the Department of Agriculture, and encourage him to study them. They are very inexpensive, and furnish a valuable supply of knowledge. Have him contact your State landscape engineer so that he may become familiar with work properly done. Even one man, when he works intelligently, can do a great deal of good. You may be able to get a windfall in the way of a W.P.A. project, which will furnish men to work under his supervision. Public utilities which do trimming within your right of way may often be convinced that proper methods of trimming will reduce ultimate expense. The Bell Telephone Company has a very complete manual, compiled by experts, which covers every phase of this work. As he progresses and becomes more familiar with trees, he will learn their habits and about how much trimming and thinning are satisfactory.

In the matter of clearance for sight distance, your State landscape engineer can render valuable assistance. He can also show you the proper methods for progressive thinning over a number of years. When new planting is attempted, a visit to one of your local nursery men will prove beneficial. He can show you how different types can be most successfully set out, and during what months planting should take place.

The material may come from one of a number of sources. Local garden clubs may get together and furnish plants. This has been done in many localities. Schools and colleges often have material that they would be willing to donate for work of this type. Grade school children can successfully raise small stock in gallon cans, to be placed later in five-gallon cans before setting out or moved into nursery rows for bare rooting. School gardens are not uncommon, and there is no reason why a small amount of work of this type could not be successfully undertaken. Stock might even be raised by one group for one specific project, in which case the knowledge that they would have a personal part in it

A grove of mesquites in their native habitat. A very hardy tree for arid districts, slow-growing and difficult to transplant, but may readily be propagated from seed and set out in gallon cans.

The same grove after selective thinning and cleanup to reduce fire hazard and afford a better view of farm lands (not visible in picture). Trimming has been confined almost exclusively to lower part of trees.

would have an added incentive for their activity. Where labor is scarce, public service clubs could be organized to set aside one particular day or days for planting, with a picnic thrown in for good measure.

However, before any planting is done, careful, intelligent study should be given to the location, for after the trees are once in the ground, the work really begins. Try wherever possible to plant near an adequate water supply. If you don't, you will have years of work and thousands of gallons of water to haul, unless you are willing to sit down and let the project die.

Planting Trees

In planning for roadside improvement, look over your system and see what you have to work on. The heaviest traveled roads should come up for primary consideration. This holds true for two good reasons: First, the clean-up of borrow pits, backslopes and undesirable growth on these roads increases their safety factor for the traveling public; second, the more people that see your work, if it is good, the sooner will public sentiment swing over to your favor.

Go down the line and clean up well first. There is always plenty of time left for planting. In fact, in many places you may find that no planting is required. Do a good, thorough job on the stretch on which you are working, rather than a haphazard schedule scattered at random over your entire system. Make a definite outline of the work to be done, and then tackle it in an orderly, progressive manner.

The actual preparation of plans for planting should receive the advice of an expert. Again a visit to your State landscape engineer will be of help. He can show what things are good and bad from a standpoint of design, show you how to achieve the best results with the least money, and will probably have several sets of duplicate plans of his own projects that he will gladly lend for purposes of study. Many of your smaller jobs will not require the preparation of formal plans but can be easily done on the ground, once the principles involved are known. A few timely "don'ts" and "do's" may be well considered at this point. While they are not all embracing, they will serve as a useful basis on which to work. When considering a locality for a planting project, first make sure that you have plenty of room and that the alignment is permanent. We can't always look very far into the future, but the establishment of material on a definite location is usually much more satisfactory than planting a stretch that is subject to change. The matter of adequate space cannot be stressed too much. Where clearance is impaired by utility lines, narrow rights of way, and irregular encroachments, you are liable to find that your planting in time will become a menace rather than the thing of beauty and joy forever that you intended it to be.

Sometimes spaces that are not too badly crowded can be put to use through a careful selection of material. For instance, if you are crowded by utilities, plant material whose ultimate height is low. Near intersections and other locations where sight distance is of vital importance, the use of either extremely low or very high-headed varieties is recommended. Keep in mind the water situation, or you will regret it to the plant's dying day.

Select, or if necessary import, good soil. The slight added expense will be more than repaid. Also use types of material that adapt themselves readily to your situation. For instance, the planting of eucalyptus in a soil with a very tight makeup will not be nearly so successful as the planting of that same material in a gravelly open soil. Pines and other evergreens, generally speaking, do not like their feet too wet. In exposed, windy locations the use of types that are brittle and subject to breakage should be avoided. In other words, before you put anything in the ground, regardless of how elegant it may look in somebody's back yard, ask yourself "Will this fit the requirements of my job?"

Top—Typical planting of cacti and other desert growth. Large center cactus is a crested saknaro, a very rare freak.
Middle—Moving a giant cactus. Notice heavy planks and mattresses used to prevent bruising or breakage. This cactus weighed about 1½ tons, and necessitated use of a winch and guy wires in placing.
Bottom—A typical scene in the Missouri Ozarks. Notice how the three trees on the outside of the curve serve as a guide for traffic. The informal group of trees on the left side of the summit helps greatly in adding interest to the sky line.

Another thing to consider is the damage that may be inflicted by or through man. Planting too close to fences or in areas where stock is driven necessitates the placing of tree guards to prevent mutilated growth.

And lastly, sadly too, it is not a good idea to attempt to plant flowering, fruit or nut bearing stock, for people will invariably ruin the plants in an effort to gather the flowers, fruit or nuts, as the case may be.

Oh, yes, there is another item, and an important one, too, that I almost missed. Be sure that you know the root habits of the material that you use. Some types are taprooted, and head straight for water, while others like to run their roots all over the country near the surface of the ground. If these latter types are planted in parkways or restricted areas near sidewalks and pavement, the upheaval of soil or concrete is almost in-

evitable; for when roots and structures tangle, the structures always lose. Where water is scarce, and planting really desirable, types can usually be found that will adapt themselves inside of two years, requiring no further attention. We have a number of desert varieties that work admirably if they receive sufficient attention to pull through for the first couple of seasons. If, however, after scanning your list, you find that there are not such plants in your territory, you would be wise to seek elsewhere for a planting location.

Cost Considerations

Last but not least by a long shot, we come to that haunter of balancers of budgets, that enemy of the communists, demon who causes grey hairs, old man cost. He really isn't so bad, though, if you don't bite into him too deeply, and feel your way carefully as you go. Let's assume that your county lies in the category of the $150,000 to $300,000 class. The first thing to do is set up an arbitrary percentage for spending on this work. The Bureau of Public Roads sets a minimum of 1% of Federal Aid funds for State highway system. Some States spend a good deal more than that—say around 5% or even 7%. As a matter of conservative policy, let's set our amount at from 1% to 2%. This will give us from $1,500 minimum for a $150,000 to $6,000 maximum for a $300,000 county.

Let's see what we can do with $1,500. Trees can usually be trimmed for an average of two to three dollars apiece. This isn't surgery in its higher forms, mind you, but you can take out a lot of deadwood, and do a nice job of shaping if your workman knows what he is doing.

Tree saws are not expensive. They range in price from one to about $10. There is a dandy all-round saw that sells for about $3.50, which is 2½ feet long, carries three points to the inch, and is capable of cutting a lot of wood. For general trimming it is better than the larger saw because it can be satisfactorily worked in tight places, does not tire the sawer, and yet the teeth are large enough to keep from gumming in green wood. Pruners run from a dollar for the 24-inch hand variety to about $4.50 for the long-handled type, suitable for working small branches up to fifteen feet from the ground.

Your Bordeaux and linseed oil mixture will cost about the same as paint, say $2 per gallon. The wood should be slightly calloused before its application, to prevent blistering. Its application should not be overlooked, for it is the safest means of preventing infection in the tree. Spraying costs about $6.50 per mile. Fortunately, this is not necessary in all sectors, but very important in areas subject to certain fungi and insect pests.

Tree removal is a bit more expensive than trimming, running up as high as $10 for a three-foot tree. It is not necessary to pull stumps, as long as the roots are severed below the ground. People living in the vicinity of the job are usually glad to get your trimmings for fire wood. The smaller stuff can readily be piled and burned.

New planting will vary considerably in price, but a good general rule to follow is $1,000 per mile for continuous planting on both sides. This will cover the cost of material, staking, holes, fertilizer, mulch and painting for trees set at between forty and sixty-foot intervals. It is not advisable to attempt planting trees that are very large; they undergo a more severe shock in moving, unless very expensive means are used, and will often be surpassed in growth by smaller stock set out at the same time. Another objection to large stock is that its growth is frequently retarded by confinement in cans or boxes in the nursery.

Evergreens up to five feet are desirable sizes, and their cost is not excessive, around three to four dollars being an average price for such material. Deciduous stock of from one to two inches in caliper is most readily set out. This stock will run from six to ten feet in height, and 60 cents to $1.25 in cost. Five-gallon-can stock for eucalyptus and similar types costs from one to one and a half dollars each, the stock being from six to eight feet high. Palms run from a dollar to a dollar and a quarter for four-foot ball stock. Small shrubs and vines in gallon cans may be had for an average cost of thirty cents.

Tree holes run an average of thirty cents each, varying considerably with the size of the tree. Fertilizer (manure) runs about two dollars per ton, or one cent per tree. Stakes are worth an average of ten cents each for rough sawed 2x2, 10 feet long, and three-legged guards fifty cents each.

These planting costs are very general, the details naturally varying in different localities, but will give a rough estimate on what can be done. Your irrigation ditch, if you build any, should not cost more than eight cents a foot when dug by hand. Where a blade is available, the same ditch, about one by two feet, can be put in for a cent and a half a foot.

This is the briefest of explanations; but in a country where prices vary between wide limits from year to year, and especially in accord with supply and demand, it is about the best I can offer as a general basis on which to work.

It is my sincere hope that these articles have stirred up enough interest for you, as county engineers, to give roadside improvement a trial. The field is open. Your State landscape men will be glad to give you their cooperation—and the public will welcome your efforts. That is already known. Go to it, let's see what you can do.

Dust-Collecting Machinery for Roads

Experiments carried out in 1935, mainly on gravel roads, showed that dust could be completely removed from roads by means of suitably designed machinery. The machine employed consists of a wheeled container carrying a rotating brush; this collects the dust, which is then thrown against a projecting shield and blown by compressed air up a curved channel into the body of the vehicle, where it is intercepted by a screen which permits the escape of air. Nearly 99 per cent. of the dust collected from one of the gravel surfaces tested passed a 0.01-cm. sieve. The machine can either function as an independent unit, or be drawn by a motor lorry. T. B. LOFTHEIM: *Meddelelser fra Vejdirektoren* 1936, 6, 90-5. Road Abstracts.

Specifications for Materials Should Be Part of Contract

In an action for balance due on a contract for the sale of sand and gravel to a construction company, a defense was that certain parts of the sand and gravel did not comply with the contract specifications. The Iowa Supreme Court held, Koch Sand & Gravel Co. v. Koss Const. Co., 266 N. W. 507, that a provision of the construction contract that the sand and gravel was to be subjected to a laboratory test was not binding on plaintiff, because the contract specifications were not made a part of its contract, which provided merely that the material be inspected at loading and become the property of defendant on delivery at the place specified.

Equalizing Flow to Treatment Plant from Intermittent Pumping

By MARSHALL N. HAMMON, JR.
Borough Engineer, Audubon, N. J.

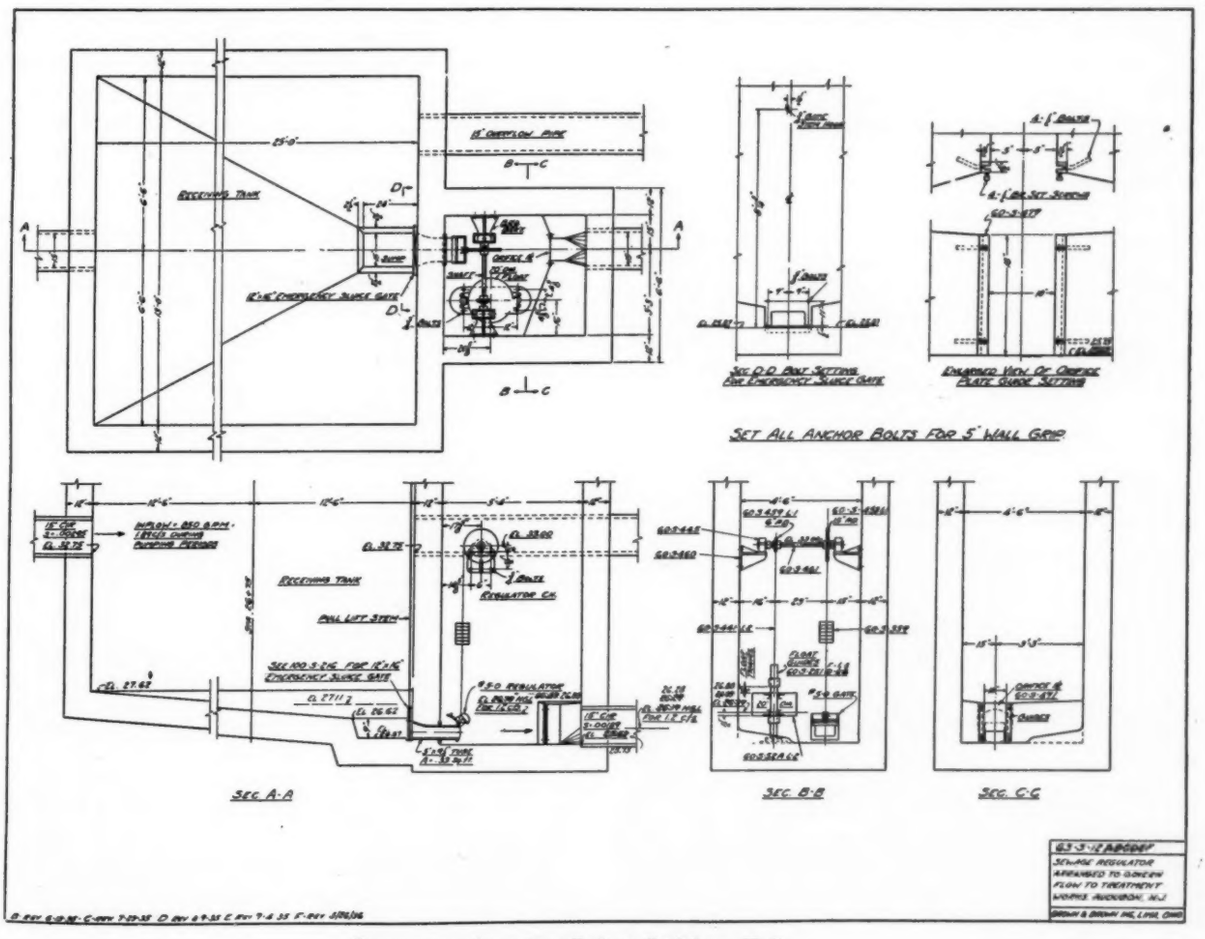
THE Borough of Audubon, Camden Co., N. J., in 1913 constructed a sanitary sewer system on the separate plan and a treatment plant. As a low part of the borough along Nicholson Road could not drain by gravity to the plant, the sewage from it was collected at a point near the east end, where was installed a pumping plant which lifted it 36.25 ft., through a 6" cast iron line running south 915 ft. through Atlantic ave., to a 15" gravity sewer in Merchant street, the principal business street of the town. The Merchant street sewer received most of the rest of the town's sewage also and carried it by gravity west to the treatment plant, about 5,000 ft. from Atlantic ave.

Originally the pumping at the Nicholson Road pumping station was done with two 4" centrifugal pumps which were operated alternately. Increase in sewage as the town grew necessitated increasing the size of the pumps to 5" in 1918, and again to 6" in 1921.

Between 1920 and 1930 the borough's population increased from 4,740 to 8,904, the rate of increase being further indicated by the number of sewer connections —1010 in 1918, 1202 in 1920, 1327 in 1921, and 2477 in 1928. In 1932 there were 2495. No figures of quantities pumped are available, but flow meter readings at the treatment plant indicated that during 1934 n average of 210,000 g.p.d. passed through the Nicholson road pumping station.

By the spring of 1928 the flow had so increased that the 6" pumps were operating almost continuously. Infiltration into the sewers was high and the capacity of the pumps was frequently passed during storm periods. with the result that the receiving wells filled and the sewage backed up into the lateral sewers. To remedy this an additional 8" centrifugal pump was installed, which thereafter did all of the pumping. The installation of this pump was faulty and extensive repairs were necessary within six months and at six or eight-month intervals thereafter, until, during the winter of 1932-33, it could no longer be operated without complete overhauling—in fact, when taken out was found to be practically worthless. Pumping with the old 6" equipment was renewed until other plans could be prepared.

Meantime other difficulties had developed which entered as factors into the changes made. In the spring of 1932 a longitudinal split was found in the 6" cast iron pumping main caused by excessive pressure due to the



Sewage regulator installed at Audubon, N. J.

high pumping rate. Furthermore, increase in the total sewage carried by the 15″ Merchants street sewer had become so great that, during periods of high pump discharge, sewage rose in the manholes and on a number of occasions forced the manhole lids up and flowed onto the street surface. Therefore in the judgment of the writer it was useless to increase the capacity of the pumping plant and its discharge line without increasing the size of the receiving line in Merchant street. As Merchant street is paved throughout the developed section of the town with 7″ reinforced concrete and with sidewalks and is a closely developed business section containing numerous underground utilities, the cost of replacing the sewer with a larger one would have been prohibitive.

The solution that was reached was to relocate the pump discharge line in an entirely new position. Nicholson road, on which the pumping station is located, is approximately parallel to and 800 ft. north of Merchant street and at much lower elevation, and was not paved with a hard surface and contained only 8 dwellings along the proposed sewer. By laying the discharge line west on Nicholson road the lift could be reduced to 20.25 at the summit, a saving of 16 ft.; from which point it would flow by gravity to the treatment plant.

It was estimated that by 1959 there would be 365,000 g.p.d. to be pumped and a total flow to the treatment plant of 1,320,000 g.p.d. The new pumping plant and discharge line were designed on this basis, and a 10″ cast iron pipe laid 1900 ft., where it discharges into a new 15″ terra cotta gravity line, which continues west along Nicholson road about 600 ft., then turns south through a 15-ft. right of way and joins Merchant street beyond the end of the pavement. From here to the treatment plant an additional line of 18″ pipe was laid paralleling the old 15″.

Equipment for Equalizing Flow

The most interesting feature of the new construction was a structure built for the equalization of flows. It was recognized that, with the new pumping system, there would be a considerable fluctuation in flow at the treatment plant, with consequent disturbance in the action of the Imhoff tanks. Several methods of controlling this were considered, variable-speed motors on the pumps, multiple pumps of varying sizes, power-operated control apparatus, and finally a mechanical flow-control apparatus. The last was finally adopted. It was somewhat cheaper initially and would require less maintenance than any of the other forms, operating costs would be eliminated entirely, and lastly it was of a simple design so as to require no expert assistance in either operation or maintenance and the sewage department would therefore be fully capable of both.

Several types of mechanical control were considered. One manufactured by Brown and Brown, Inc., of Lima, Ohio, was finally adopted. The principle of this control is that the pump discharge flows into a receiving well at the end of the pump discharge line, which well is 25 by 13 ft. by about 7 ft. water depth. From this well the discharge is through an orifice throat, the outfall end of which is governed by a float-controlled circular shear gate. The float is located in a float chamber separate from the receiving well and receiving the discharge therefrom. The float chamber discharges into the sewer over a thin-plate weir. If water rises above the desired depth on this weir, the rising float reduces the opening in the orifice throat, and the flow can thus be controlled so as to give a uniform flow independent of the operation of the pumps; the 17,000-gal. receiving tank holding any temporary excess of pump discharge and releasing it as the pumpage decreases. This adjustment was obtained to such a nicety in this installation that the flow meter at the plant shows a variation of about two hundredths of a foot in height over the Imhoff discharge weir. The writer has no doubt that with a little experiment even this small variation could be eliminated. This variation is, however, negligible in comparison with the variation caused by the old 8″ pump, which was about 0.18 foot over the Imhoff weir.

The above reconstruction was completed in the fall of 1935, and to date has been most satisfactory, no part of the installation giving any trouble whatever.

Incineration of Municipal Refuse

(Continued from page 22)

Utilization of Heat

In several plants built about 1907, boilers were installed for utilizing the heat from combustion of the refuse. These plants performed satisfactorily for many years, most of them up to the present time. One of them has recently been enlarged and continues to sell its steam to the local public utility. At the Providence plant, recently completed, with waste-heat boilers operating at a little more than 200 lb. pressure, electricity is generated and is used in the adjacent activated-sludge sewage treatment plant and for pumping sewage. The Manchester, N. H., plant, under construction, is provided with a boiler capacity of about 11,000 lb. of steam per hour, for use in the adjacent asphalt plant, at a pressure of 150 lb. At this writing, New York City is said to be negotiating with a private concern for the sale of steam from one plant, now under construction, for which the annual charge will be in the neighborhood of $200,000.

The Rochester incinerator will generate at peak load about 50,000 lb. of steam per hour, for use in the adjacent garbage reduction plant. The boilers are designed for 250 lb. pressure and it is expected that surplus steam may be sold to the Rochester Gas & Electric Company, whose generating plant is adjacent to the garbage plant and from which steam is now purchased by the city. In order that the production of steam at the incinerator may always be synchronized with the demands of the reduction plant, auxiliary oil burners are being provided under the boilers. Burners also are being provided on the furnaces themselves, to facilitate combustion on those occasions when the refuse is extremely wet.

Chimney design has been greatly modified in recent years. When maintaining high temperatures of combustion in plants in which the flue gases are not cooled by passing through boilers, it is necessary to line chimneys with refractory materials. With the frequent wide changes of temperature of the gases it has been found advisable with independently supported linings to provide a wrought iron corset. In addition, a renewable target wall for the bottom portion of the chimney is commonly provided. In the Charleston, S. C., plant a refractory lining supported sectionally on the radial brick chimney shaft, has been used, in this case the greatest thickness of lining being a single 4½-inch course of firebrick.

It is said that a multiple-hearth incinerator is being constructed at Kokomo, Indiana, to burn a mixture of sewage sludge and ground garbage. Several other such plants are contemplated.

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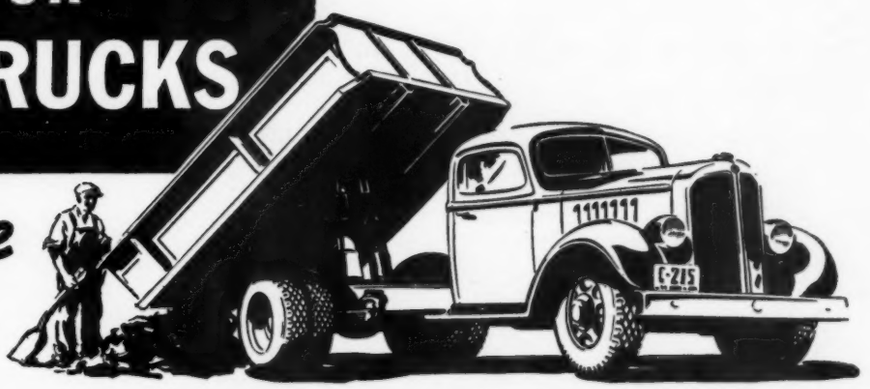

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TIRES FOR DUMP TRUCKS

Plant-Mix Bituminous Construction

A review of the methods and equipment for constructing plant-mix bituminous surfaces, using stationary, portable and traveling plants. Design of mixers, operation.

PLANT-MIXING of aggregates and bituminous materials permits more accurate control of proportioning and mixing than is possible by road-mix methods. Surface treatments, road mixes, etc., may be constructed with plant-mixtures, except for the one operation of priming or tack-coating. Surface treatments at the rate of 30 pounds per square yard are now frequently done by spreading pre-mix material, and even the large aggregate used in penetration macadam may be plant-mixed by suitable adjustment of mixing blades. Beginning first with the use of hot bitumen cement as binder, plant-mixing now extends to the use of all grades of bituminous materials, and to the manufacture of cold laid as well as hot mixes.

The plants themselves are of three general types—stationary, portable and traveling. Stationary plants are those permanently established, such as municipal plants. Portable plants are those used by contractors and while often much larger than many of the stationary plants, are designed structurally for ease in dismantlement and assembly. Traveling plants are those where mixing units are mounted on a chassis which can move under its own power, and, picking up aggregates from a windrow on the road, moves ahead depositing the finished mixture behind it.

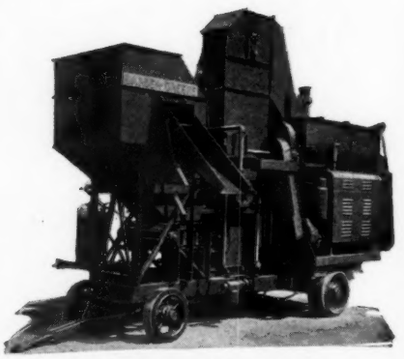
Plants vary from very simple units to very complete layouts, and choice is determined by regard to kind and volume of work. The simplest plant is a concrete mixer, in which aggregates, proportioned by wheelbarrow or shovels, are used in undried condition and with bituminous materials that do not require heating.

Portable or stationary plants consist essentially of five principal parts:

1. An aggregate heater called a drier.
2. Screens and bins for separating and storing the hot dried aggregate.
3. Tanks for storing and heating bitumen.
4. Devices for proportioning the aggregate and bitumen.
5. A mixing box and blades.

In some plants all the operations are mechanically controlled by time locks and automatic releases.

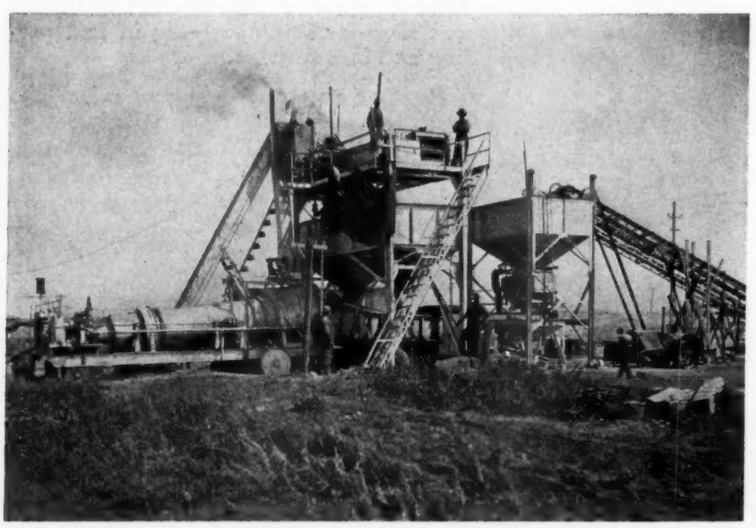
The drier is usually a long cylindrical rotating steel drum, mounted at a slight angle from the horizontal. The unheated aggregate is fed into the higher end, and passes through to the lower end, being heated and dried in its passage by hot gases from burners (usually oil). The drier should have an electric pyrometer at the discharge chute to register temperature of aggregate as it passes to the screens and storage bins. The drier is usually the bottle neck of a paving plant and ample capacity should be assured. Capacities range from 10 to 100 tons an hour or more.



Barber-Greene Mixing Plant.

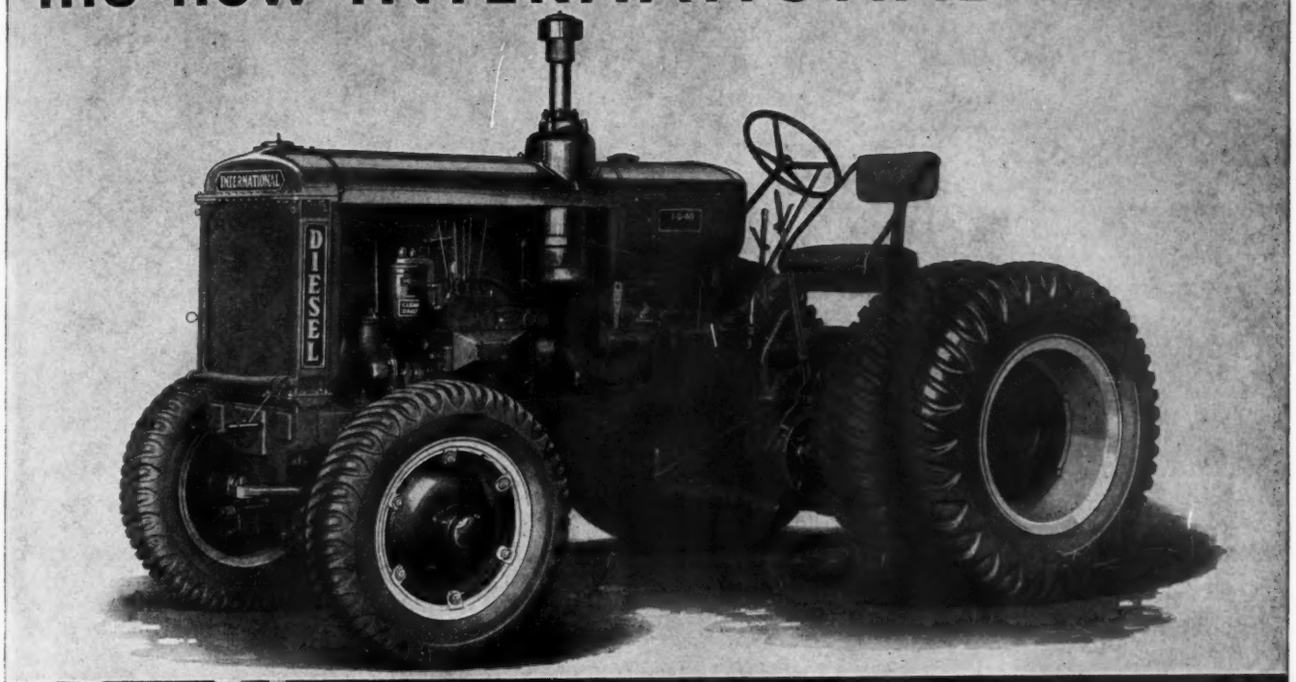
Screens may be either of rotating (cylindrical) or vibrating type, and are located directly above the storage bins. Aggregates are fed to the screens by the elevators which lift them from the discharge end of the drier. Screens should have sufficient capacity so that complete separation of aggregates into various sizes is accomplished. Vibrating screens are coming into common use. The screen setup should provide for rapid change of sizes when it is desired to change the character of plant mixture. Storage bins are provided for each size aggregate and should be so constructed that overflow from one bin to another cannot occur. The discharge gates should be of a type that will open and shut quickly, and will prevent leakage when closed; and are located directly over the weigh hopper.

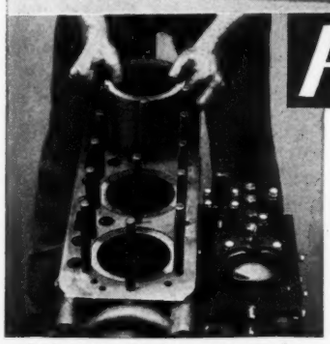
Heating kettles and hot storage tanks which deliver bitumen directly to the weigh bucket should be equipped with thermometers and positive means of control of temperatures. They should have a total capacity for not less than one day's run of the plant. They should be heated preferably by steam or electrically, and insulated lines and connections should be provided between tanks and weigh



The Iowa Portable Plant.

America's FIRST Diesel-Powered Industrial Wheel Tractor . . . the new INTERNATIONAL ID-40





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The Model ID-40 is as easy to crank as a gasoline tractor of corresponding size.

Power, Quality and Economy

● International Harvester, world's largest tractor builder, scores another *first* with the new Model ID-40. This organization has adapted the Diesel principle to wheel-type industrial tractor operation, the first time this has been done in America. This new tractor uses the same International Diesel engine that has proved so successful in the International TD-40 TracTracTor and the Model PD-40 Power Unit. The Model ID-40 Tractor has power and stamina to handle a variety of heavy-duty work calling for a wheel tractor. Investigate this new addition to the line of International Industrial Power, which includes wheel and crawler tractors, and power units from 12 to more than 100 h. p.

INTERNATIONAL Model I-40

This tractor is also new in the International Industrial Power line. It is similar in design and construction to the Model ID-40 but is powered with the efficient 6-cylinder gasoline engine used in the Model T-40 TracTracTor. Both of these tractors have the well-known features of International manufacture which mean so much to the user in low operating costs and maintenance economy.

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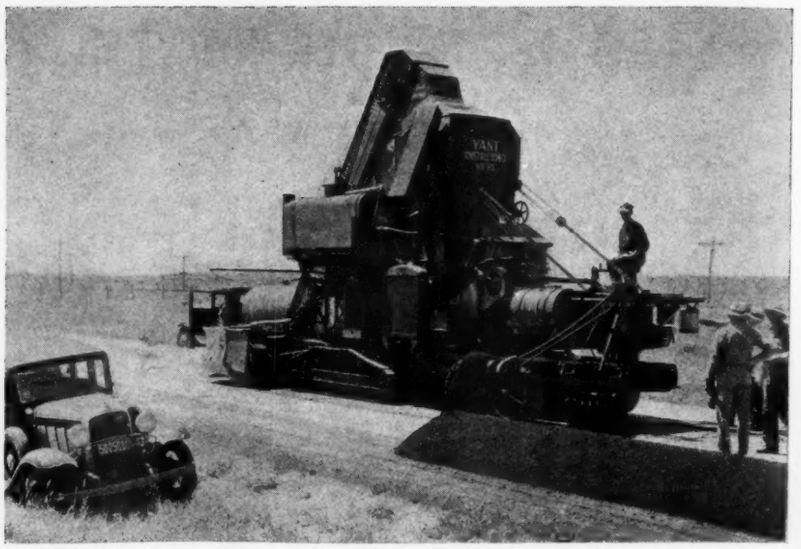
INTERNATIONAL HARVESTER

bucket to prevent chilling. Continuous circulation of bitumen between kettles and weigh bucket is desirable and will soon pay for any extra cost as compared with dead-end connection.

Measuring or proportioning devices consist of a weigh hopper for aggregates and a weigh bucket for bitumen. The weigh hopper is directly under the storage bins and directly over the mixer. It may be equipped with either dial or beam scale, sensitive to ½ of one per cent of the largest load that may be used in one batch. When of beam type, there should be a separate beam with tell-tale indicator for each size aggregate to be weighed, and a tare beam for balancing the hopper. The hopper is usually rectangular in shape, open at top and with a full length discharge gate at bottom to permit quick and complete dumping as soon as weighed.

The bitumen weigh bucket should have sufficient capacity to hold at least 20% of the weight of a batch of aggregate. It should be insulated to prevent chilling and accumulation of bitumen on the sides. It should be suspended on dial or beam scales so arranged that the tare weight of the bucket will be shown at each weighing, and the net weight of bitumen measured within 1% of that required for one batch. The bucket should discharge the bitumen in a thin uniform sheet over the full length of mixer.

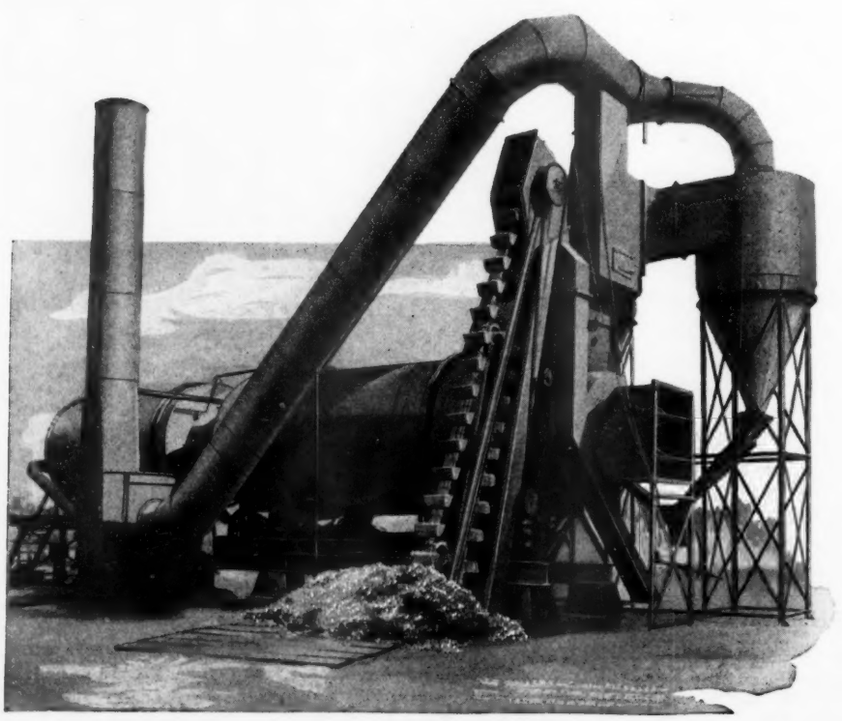
The most common type of mixer is the twin pug. It is set in the floor of the mixing platform directly under the aggregate weigh hopper, and so arranged that it can discharge directly into trucks below. The twin pug mixer consists of a rectangular steel box with semi-cylindrical bottom, and a bottom gate which extends for practically the entire bottom area. The mixing device consists of two shafts rotating in opposite directions at a speed of approximately 70 r.p.m. to which are attached removable mixing blades, set at an angle. The clearance of the blades is adjusted according to the character of mixture and should be not more than ¾ inch for fine dense aggregate mixtures and not over 1½ inches for coarse graded mixtures. The mixer box should be enclosed to prevent loss of dust, and equipped with lock timing device to control period of mixing. The bottom gate should be tight to prevent leakage during mixing. Mixers are made in various sizes from 750 to 6,000 pounds. For ordinary contracting work or central mixing, a minimum size of 2,000 pounds is recommended. This size will turn out from 25 to 60 tons per hour according to character of mix.



The Barber-Greene Traveling Plant picking up material from a windrow in the road and depositing mixed material at the side.

Another type of mixer consists of a horizontal rotating drum or cylinder, with a manhole through which the aggregates are charged while the cylinder is at rest. After clamping the manhole cover shut, the cylinder is revolved and the aggregates are cascaded over a series of baffles. Bitumen is sprayed in under pressure, and mixing is then continued for the appropriate period.

The batch method of mixing is desirable for the hot-mix types where very careful control of proportion is essential. Specifications should contain paragraphs giving minimum plant essentials. Carefully controlled plants of modern design not only turn out more uniform mixtures but they are far more economical than old style outfits, output often being 50 to 100 per cent greater due to elimination of lost time formerly experienced with unbalanced equipment. A number of manufacturers make complete plants not only of a regular type, but for special situations, where unusual problems are encountered. Stationary and portable plants are furnished by Hetherington & Berner, Simplicity, Cummer, White and Blouch.



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Quick-acting, accurate hydraulic controls give fast, safe adjustment to varying ground conditions. Blade is held in absolute control at all times by ingenious combination of long wheelbase, wide front axle with leaning wheels, a large diameter circle, Dual (8-tire) Drive, positive hydraulic controls, and a unique anti-chatter device. Side draft is eliminated. You get a full cut every trip. And a six speed transmission gives you just the right speed for each job at an economical r.p.m.

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When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 55-57

Traveling Plants

In the traveling plants, heating of the aggregate is not required. The measurement of the aggregates and of the bitumen is accomplished by flow control, and mixing is continuous instead of by batch. The liquid bitumens used are at lower temperatures than in the batch plants.

The traveling plants consist essentially of a bucket elevator that picks up the material from the windrow on the road, and deposits it in the bins above the mixer; and a mixer of the continuous type. The mixed material is deposited in a windrow behind the machine; or, if desired a side discharge elevator is attached at the rear, and the mixed material is dumped on a primed strip along one side of the road surface. This keeps it away from traffic.

Traveling plants of the type described above are made by Cedar Rapids and Barber-Greene. These plants are also suitable for use as central plant mixers set up at stockpiles, gravel pits, etc., and will produce from 1 to 1½ cu. yds. a minute of mix. When used for such work, they may be equipped with driers, hot aggregate storage, elevators, etc. The mixing unit of one of the Barber-Greene models is especially designed for use as a central mixing plant, being easily uncoupled from the elevator or loader.

The Jaeger Bituminous Paver.

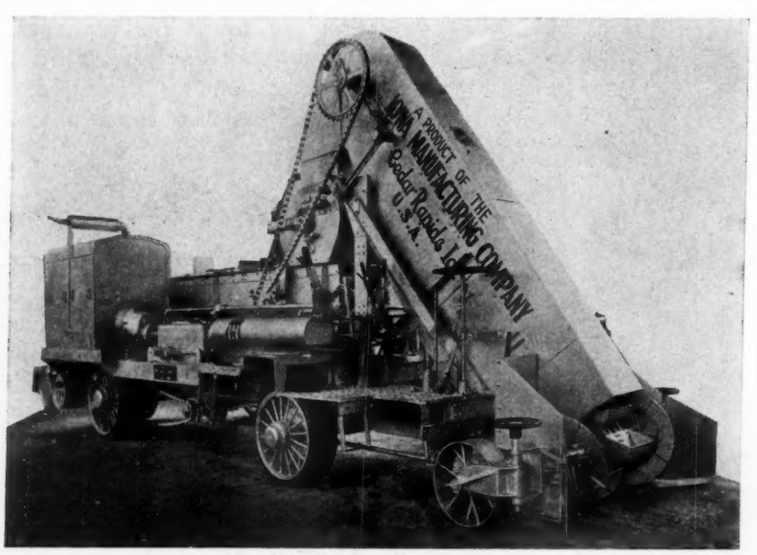
A finisher can follow closely behind the mixer and spread and compact the material; in fact one type of machine (Barber-Greene) includes a spreader which can be directly attached to the rear of the traveling plant, so that the entire operation of picking up, mixing, placing and spreading is completed in one passage of the machine. Similar finishers, for use in spreading and compacting any type of mix, are made by Jaeger and Adnun (Foote Co.).

★ ★ ★

Plant Operation

There are a wide variety of types of bitumen mixers, some of which require complete drying of aggregates and use while hot, others drying and then cooling to 100° to 125° F., and a third group where partial drying and immediate mixing is accomplished. The temperature of aggregates from the drier therefore varies somewhat, and also the temperature of the bituminous material at the time of mixing. For sheet asphalt, hot-laid bituminous concrete, stone-filled sheet asphalt and similar types, the asphaltic cement should be heated to from 250° F to 350° F. Aggregates as discharged from the drier should be from 225° F. to 350° F. for coarse aggregate mixtures, and 275° F. to 375° F. for fine aggregates. Filler is not heated, but is added to the mix at atmospheric temperatures. Tar cement for plant mixes should be heated to 125° to 225° F. Where mixed aggregates are fed to the drier, they should be substantially in correct proportion so that the storage bins will be supplied at the proper rate, and it will not be necessary to empty one or more bins to prevent them from running over.

In charging the mixer, the coarsest size should be fed in first and so on down to the filler. Usually the mixer is operated for at least 15 seconds of dry mixing before adding the bituminous material, with a minimum of 20 seconds for wet mixing thereafter. Time will vary according to fineness of mix, especially with filler (passing 200 mesh). Some of the modern hot-mix plants running coarse graded bituminous concrete have successfully operated on a 40-second cycle, turning out a completely uniform product in this period. As a rule, the cold mixes require a somewhat longer mixing period than hot mixes.



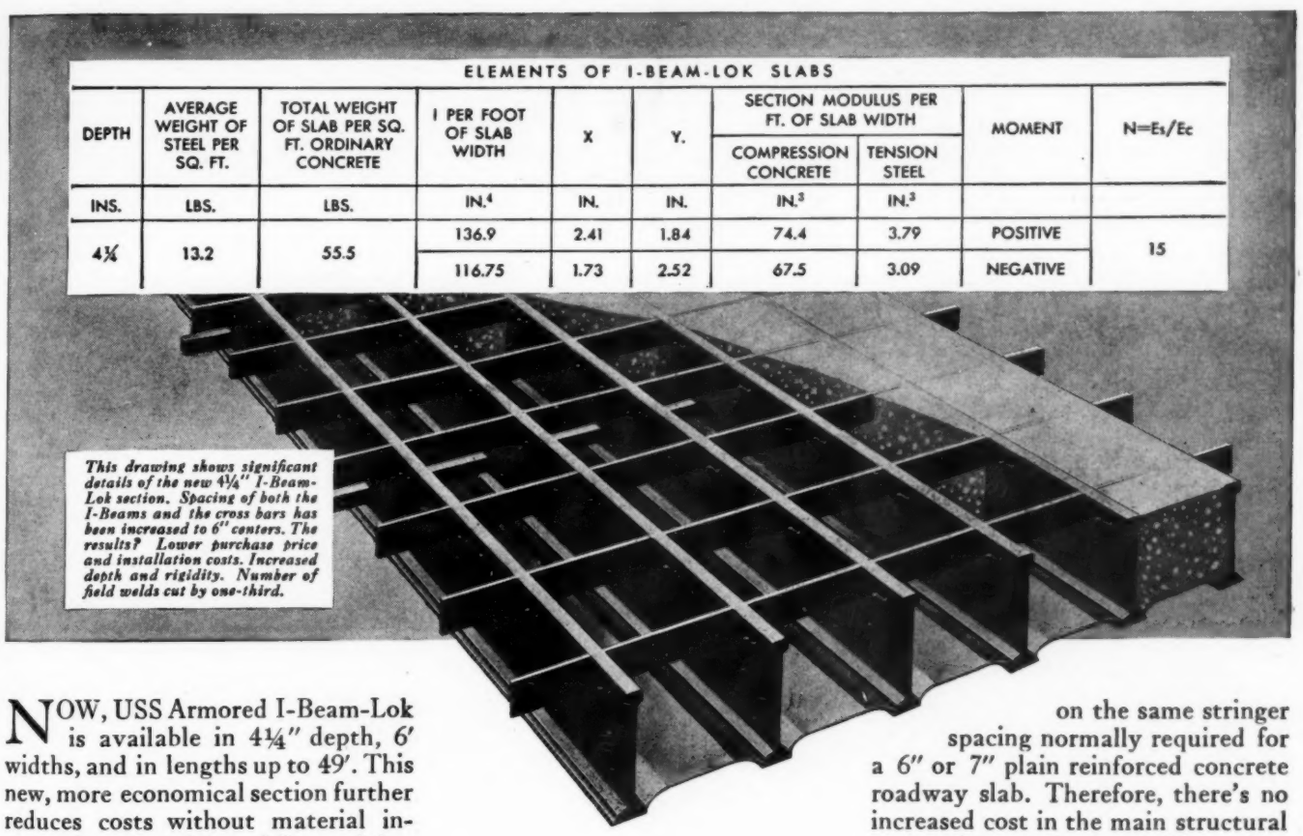
The Iowa Traveling Plant.

A NEW I-Beam-Lok Unit

[DEEPER! MORE RIGID! MORE ECONOMICAL!]

ELEMENTS OF I-BEAM-LOK SLABS

DEPTH	AVERAGE WEIGHT OF STEEL PER SQ. FT.	TOTAL WEIGHT OF SLAB PER SQ. FT. ORDINARY CONCRETE	I PER FOOT OF SLAB WIDTH	X	Y.	SECTION MODULUS PER FT. OF SLAB WIDTH		MOMENT	N=Es/Ec
						COMPRESSION CONCRETE	TENSION STEEL		
INS.	LBS.	LBS.	IN.^{4}	IN.	IN.	IN.^{3}	IN.^{3}		
4¼	13.2	55.5	136.9	2.41	1.84	74.4	3.79	POSITIVE	15
			116.75	1.73	2.52	67.5	3.09	NEGATIVE	



This drawing shows significant details of the new 4¼" I-Beam-Lok section. Spacing of both the I-Beams and the cross bars has been increased to 6" centers. The results? Lower purchase price and installation costs. Increased depth and rigidity. Number of field welds cut by one-third.

NOW, USS Armored I-Beam-Lok is available in 4¼" depth, 6′ widths, and in lengths up to 49′. This new, more economical section further reduces costs without material increase in unit weight, while retaining all former wear-resistant, anti-skid, long-lived characteristics. The increase in weight of the finished slab (55½ lbs. per sq. ft. for 4¼" compared to 53½ lbs. for 3½" depth) is minimized through elimination of unnecessary concrete by means of unique arched form strips.

Look what the new unit does to costs. First, the purchase price of the steel units is lower. Handling costs will be reduced — greater savings in erection and field welding costs made possible by a 50% increase in unit width. (Number of field welds is actually reduced by ⅓.)

These new slabs can be installed on the same stringer spacing normally required for a 6" or 7" plain reinforced concrete roadway slab. Therefore, there's no increased cost in the main structural supporting steel of a bridge when 4¼" I-Beam-Lok is used.

Let us show you how this new I-Beam-Lok makes possible faster construction of bridge floors — how it will reduce weight without sacrificing strength — give your roadway added permanence through its alternate steel and concrete surface. Just write our engineers for the facts.

U·S·S I-BEAM-LOK *Armored*

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh *Chicago*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

Design of Mixes

The proportioning of mixtures should be based upon attainment of certain characteristics such as stability (resistance to displacement), durability (resistance to moisture and wear) and resistance to cracking. Consistent with stability, as much and as soft a bituminous material should be used as possible. The accompanying tables show proportions for the most commonly used types.

Depths of the different types surfacing are generally approximately as follows:

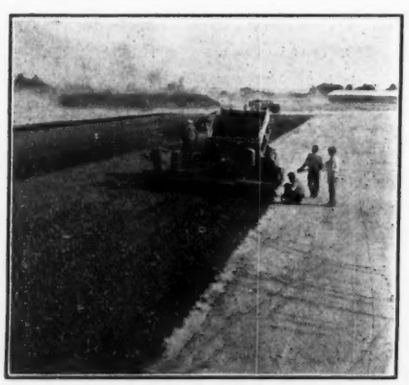
Bituminous Concrete Base.....2 to 4 inches
Bituminous Concrete Top.....2 inches
Sheet Asphalt Binder.....1 to 1½ inches
Sheet Asphalt Top.....1 to 1½ inches
Cold Laid Macadam Aggregate Surface
1½ to 2 inches
Tarvialithic, etc. ..... 1 to 3 inches
Cold Laid Graded Aggregate Surface
2 to 4 inches

Other Types of Mixes

There are a number of other cold-laid plant mixes of proprietary type, wherein powdered asphalt and fluxes are used which, after a period of amalgamation, gradually set up as a cement, and thus permit manipulation and compacting in a cold state. The foregoing, however, give common types of aggregate grading.

Hot bitumen mixtures may be hauled substantial distances by using insulated trucks and covering loads with tarpaulin. Hauls of 10 to 25 miles are common, and decision as to number of plant setups is usually a balance between moving costs and hauling costs. This same factor governs in the case of cold mixes also.

Forms are desirable for all hot mix surfaces except city work where curbs are available. Even here, for mechanical finishing, forms are increasingly used. For rural work, the conventional steel form, 9″ depth and 8″ base used for portland cement concrete, is ad-



Adnun spreader on an airport job.

Sheet Asphalt (Hot Laid)

Aggregate Size *Passing*	*Retained*	Binder Course	Surface Course
...	¼″	52-72	...
¼″	10 mesh	8-20	...
10 mesh	...	15-35	...
10 mesh	40 mesh	...	10-40
40 mesh	80 mesh	...	20-45
80 mesh	200 mesh	...	12-32
200 mesh	...	...	10-20
Per Cent Asphalt		4- 6	9.5-12

Bituminous Concrete Base (Hot Laid)

Aggregate Size *Passing*	*Retained*	Composition Coarse %		Composition Fine %	
2½″	¾″	30-60	50-65	.....	50-65
1½″	¾″	.....		20-30	
¾″	¼″	15-25		25-40	
¼″	10 mesh	5-15		5-15	
10 mesh	....	20-35		20-35	
Per Cent Bitumen		4-7		4-7	

Bituminous Concrete Surface (Hot Laid)

Aggregate Size *Passing*	*Retained*	Coarse Composition	Fine Composition
1¼″	¾″	15-25	...
¾″	½″	...	15-25
¾″	¼″	20-35	...
½″	¼″	...	20-35
¼″	10 mesh	5-15	10-25
10 mesh	200 mesh	25-35	25-40
200 mesh	...	4-6	4-10
Per Cent Bitumen		5-8	6-9

Cold Laid Macadam Aggregate Mix (Asphalt Primer Type)

Aggregate Grading *Passing*	*Retained*	Coarse Mix %	Medium Mix %	Fine Mix %
1¼″	¾″	25-60	...	...
¾″	¼″	35-75	60-85	...
Total passing.....	¼″	0-5	...	...
¼″	10 mesh	...	15-40	0-60
Total passing.....	10 mesh	...	0-3	...
10 mesh	50 mesh	...	...	40-100
Passing 200 mesh		...	...	0-5
Batch Proportions				
Mineral Aggregate		92-95	90-93	94-97
Hydrated Lime		0.5-1.0	0.5-1.0	0.1-0.5
Primer (Asphalt MC-1)		1.0-2.0	1.0-2.5	1.5-2.50
85-100 Per Cent Asphalt Cement		3.5-5.5	5-7	1.5-3.5

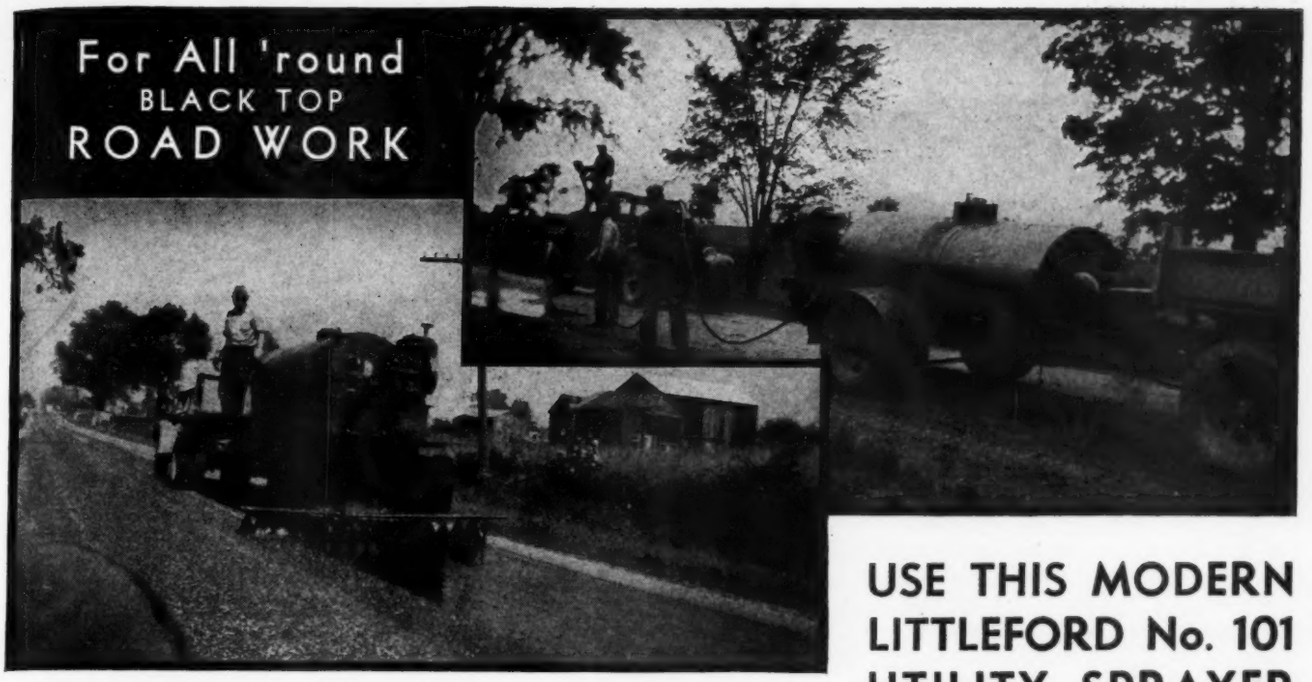
Cold Laid Graded Aggregate Mix

Aggregate Grading	Dense Type	Open Type
Passing one inch screen	100%	95-100%
Passing ¼ inch screen	50-70%	50-70%
Passing 10 mesh sieve	35-60%	35-60%
Passing 200 mesh sieve	5-14%	0-5%
Batch Proportions		
Mineral Aggregate	94-96	94-96
Bitumen Binder	4-6	4-6

For dense graded type MC-2 or MC-3, cutback asphalt, SC-4 road oil and tar Specific Viscosity, Engler, 26 to 40 at 50°C are used. For open graded type MC-3, MC-4 or MC-5, cutback asphalt, slow setting emulsified asphalt and tar Float Test at 32°C, 60 to 150 seconds, are used.

Cold Laid Tar Concrete

Aggregate Grading	Coarse Mix %	Fine Mix %
Passing 1½ inch screen	100	...
Passing 1¼ inch screen	80-100	...
Passing ¾ inch screen	20-50	100
Passing ½ inch screen	...	95-100
Passing ¼ inch screen	0-10	50-80
Passing No. 10 sieve	0-5	30-55
Passing No. 40 sieve	...	5-30
Passing No. 80 sieve	...	0-20
Passing No. 200 sieve	...	0-10
Batch Proportions		
Mineral Aggregate	95-97	90-92
Tar Binder	3-5	8-10



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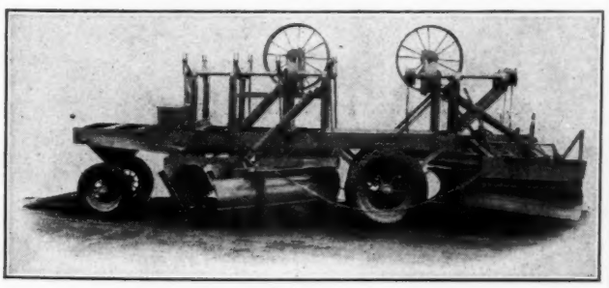

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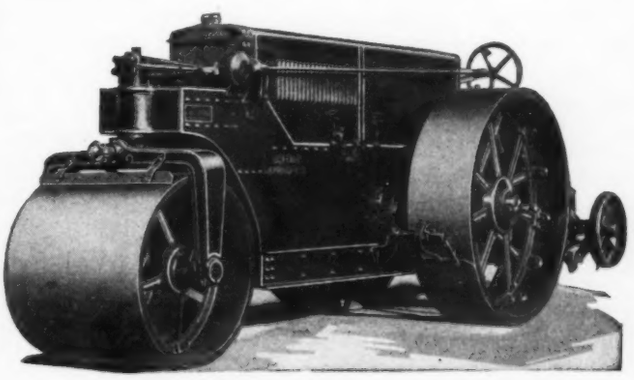

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mirably adapted, regardless of depth of bitumen surfacing. These are particularly good where old pavements are being widened and resurfaced, as, once set to grade, complete lateral support is afforded, and a high degree of smoothness is insured for the finished surface. Special forms for bituminous work are supplied also. Jaeger, Blaw-Knox, Heltzel, Truscon and Binghamton make these.

★ ★ ★

Spreading and Finishing

While much spreading is still done by hand, especially in cities where many service outlets must be encountered, mechanical spreading and finishing is becoming the usual method. For hot-laid mixes, finishers running on strong steel side forms are probably desirable, especially for surfaces over 2 inches depth, as complete control over surface smoothness is thereby afforded.

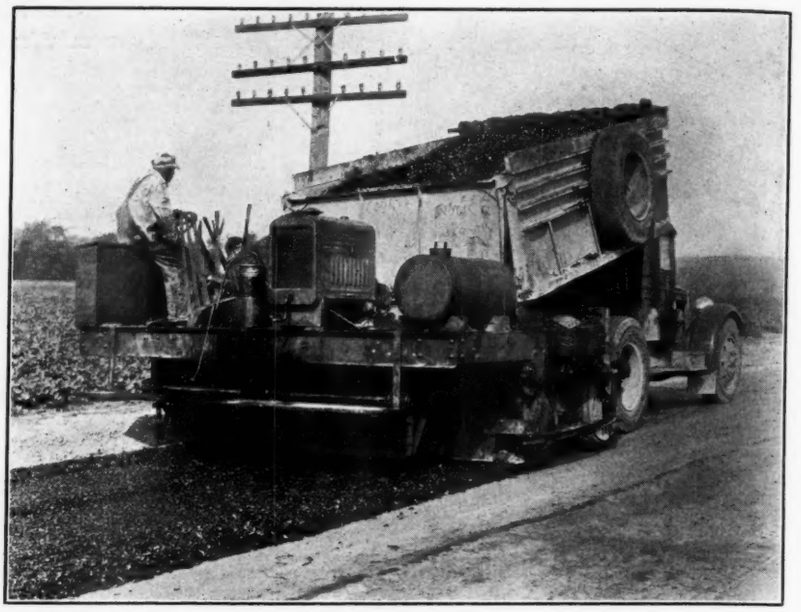
For cold-laid mixes, and in some instances for hot-laid, spreaders and finishers are available, which run on their own supports and provide for smooth surface by long wheel base, or other means of minimizing base irregularities. These are furnished by Barber-Greene, Adnun, and Jaeger.

★ ★ ★

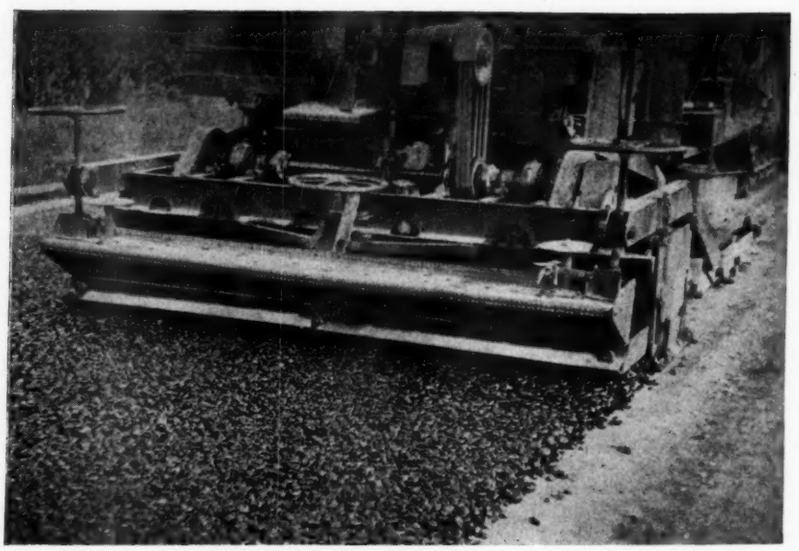
Compacting

Considerable compaction is obtained by mechanical spreading, and rolling is therefore more of a smoothing operation, especially in coarse graded mixtures. Density in sheet asphalt types is obtained by proper rolling and at the right time. Initial or "break down" rolling is preferably done with 3-wheel rollers, 10-ton size, and diagonal or cross rolling with tandem rollers. Cold-laid mixes often are compacted by a combination of blading and rolling, and cross rolling is not required.

The three-axle roller of recent development permits of increased pressure on high areas so that, properly operated, very smooth surfaces can be obtained without use of tandem roller or cross rolling.

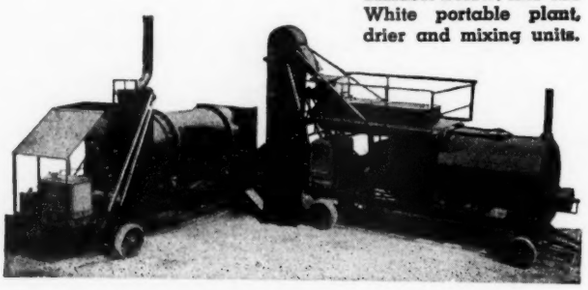


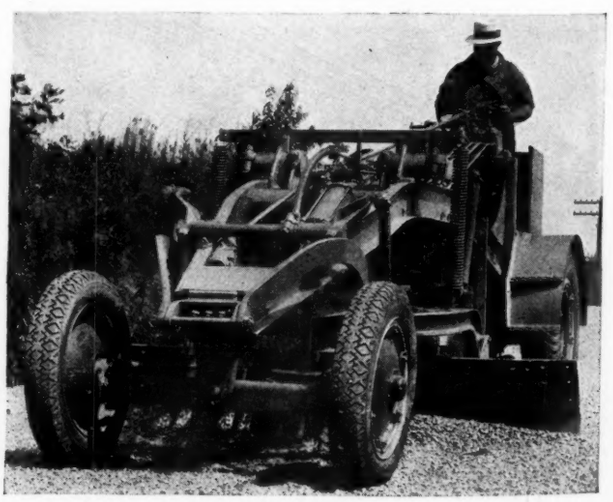
The Adnun Black Top Finisher Spreading and Compacting. Motor truck is about to dump load of mixed material into the hopper.



The Barber-Greene Finisher laying a coarse aggregate mix, which was later keyed.

Right: Grader spreading surface. Below, left: The White portable plant, drier and mixing units.





Population to Reach Peak in 1950

A declining national population is inevitable within 15 years unless the birth rate should rise or immigration increase, according to Dr. O. E. Baker of the Bureau of Agricultural Economics. "The birth rate has declined more than 25 per cent during the last ten years. If the birth rate continues to decline at this rate," Dr. Baker says, "a maximum population will be reached by 1945 or 1950. Thereafter, the population will decline; declining slowly at first, then at an accelerating rate."

A declining national population, with rural surplus and urban deficit in births, will have serious economic and social consequences, in Dr. Baker's opinion. These consequences will develop slowly and silently, he predicts, adding that it probably will be 25 years before many people will realize what is taking place. "Fifty years from now," Dr. Baker says, "there may be only a third as many children in the nation as now, and only half as many women of child-bearing age. There will be nearly three times as many old people. Many unemployed urban people will seek shelter and sustenance with relatives and friends on farms. Many of these people will start little farms, and never again return to the cities to live."

Kind of Street Improvement Discretionary With Municipal Officials

The Kentucky Court of Appeals holds, City of Louisville v. Redmon, 96 S. W. 806, that it is for the governing body of a municipality to determine whether a public way shall be improved at all, and, if it is, the manner and extent. Unless the plan adopted is so obviously dangerous as to show a failure to consider or a purpose to misconstruct the work, the judgment of the governing body as to the plan is conclusive. The town is not liable in damages for accidents that may occur on the highway because the very best plan, or even a better one, was not adopted.

Discretion of Road Commission in Awarding Contract for Trucks

Michigan county road commissioners advertised for bids for trucks, reserving the right to reject any and all bids. The statute empowering the board to purchase the necessary equipment for the road work under its jurisdiction did not require the board to advertise for bids therefor. The Michigan Supreme Court held, Bolt v. Board of Road Commissioners of Muskegon County, 277 Mich. 75, 268 N. W. 817, that the board could not be restrained by a taxpayer from making any payments on trucks purchased by them on the ground of failure to award the business to the lowest bidder, it being within the board's discretion to determine the make, type, and character of trucks they should purchase.

Snow Handling in Minnesota Cities

Winona (21,000) has a V-type snow plow and 2 bulldozers for heavy truck attachment, 3 crawler-type tractors with blades and scarifiers, and 6 bob sleighs. Street department trucks are used when necessary.

Sand mixed with calcium chloride is used on icy streets and walks by Ely, New Ulm, Virginia and Winona. South St. Paul uses cinders exclusively, except that sand is used on sidewalks, hillside streets and the business district, in some cases with calcium chloride. New Ulm thaws frozen catchbasins by dumping 40 to 50 lbs. of salt into them.

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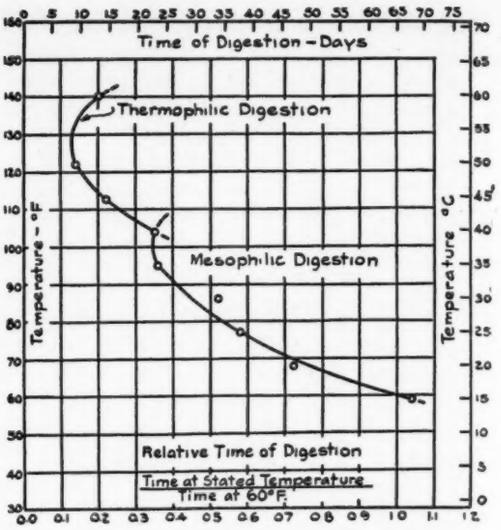
A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

The Digestion Tank

Thermophilic digestion and mesophilic, as investigated in treating a single sludge, showed distinct differentiation in time required to reach 90% of apparent ultimate gas production. The optimum temperature for the mesophilic was 98° F., giving digestion in about 22 days; while for thermophilic the optimum temperature was 128° F., the corresponding digestion time being about 8 days; these times being respectively one-third and one-eighth of those required at 60° F.[C14]

Activated carbon, powdered, aids digestion of raw sludge, judging from experiments by Keefer and Kratz at Baltimore. They report the experiments to indicate: (1) That activated carbon hastens digestion and coincidentally improves the richness of the gas (heat and power value) by raising its methane content. (2) That carbon dosage as low as 2% of the dry volatile solids in the raw sludge proved beneficial. (3) That 8% additions produced maximum improvements; whereas 4% produced intermediate but noteworthy results. (For Baltimore conditions, a 2% application was approximately 15 lb. per million gal.)[G7]

Returned sludge increases clarification, but information as to the actual effect and degree of improvement in clarification or in the saving of coagulant accomplished is rare and then often indefinite. An investigation on sewage from different sources led to the following conclusions: 1—Returned alum, Fe Cl_3 and Fe Cl_3-lime sludges have a definite clarifying value, although the same effect can usually be obtained with from 1 to 5 ppm of the coagulant. 2—The amount of returned sludge necessary with Fe Cl_3 or alum sludge to obtain maximum clarification is lower than when lime coagulated sludge is used. 3—The order of addition of returned sludge and coagulant does not seem to be important. 4—Partially treated sludges are less effective than fully treated, and over-treated sludges are no more effective than fully treated ones. 5—Acid sludges have no clarifying values, but lower slightly the pH values of raw sewage. 6—Increasing the ferric coagulant dosage decreases the effectiveness of returned sludge in clarification. 7—The return of ferric iron or alum sludges afforded additional clarification, regardless of coagulant dosage. Also, maximum clarifying action was produced when sufficient sludge was returned to give a suspended solids concentration of about 500 ppm in the case of Fe Cl_3 or alum sludge, or of about 1,000 ppm when lime was used in addition to a coagulant. A return of more than enough to give these concentrations is uneconomical. Fresh sludge (regardless of the staleness of the original sewage) is more effective than that which has been standing, but the sludge can be kept effective by use of chlorine.[C17]



Relative time required to digest well-seeded fresh sludge at different temperatures

Oxygen consumption of mixtures of sewage and activated sludge, as to rate, can be represented as the sum of three uni-molecular reactions of the same type as that used to represent the BOD of sewage and polluted waters. The first reaction has a velocity constant whose value closely approaches that generally accepted for sewage and polluted waters; the second reaction has a velocity roughly 15 times this; and the third a very high velocity constant, approximately 10 times that of the second.[C16]

Diffuser plates in Ontario, Calif., became clogged with oily carbon in the air due to orange grove smudge pots; pressure in the blower rose from 5 to 7½ lb. over night. Instead of removing the plates, city engineer Burt pumped "aviation grade" gasoline into the air-line, 2 gal. during a 24 hr. period, and the pressure dropped back to normal; apparently no injurious effect on quality of plant effluent or behavior of sludge.[G6]

Mechanical aeration by brushes and spiral circulation by compressed air were compared (see Digestion Tank for November, 1936, and January, 1937) by a series of investigations, "showed quite definitely that mechanical aeration by means of brushes was cheaper in power cost than diffused air for equal purification results"; the difference in costs of the actual aerator constructions for the two systems is negligible; but the more voluminous sludge formed by mechanical aeration requires "at least 50% greater sludge digestion, sludge return, and sludge drying bed capacity"—possibly 100% greater at some plants. "Under equal conditions of operation the brushes supplied nearly 100% more residual dissolved oxygen to the tanks than did the air, with the same power consumption. In addition, the distribution of dissolved oxygen was very uniform with the brushes as compared with a tendency for core formation with the porous tubes." Each therefore appears to have some advantage over the other.[C19]

Trickling filters in Ohio have continuously produced a stable effluent in most cases when loadings have not exceeded 250 lb. of 5-day BOD per acre-foot, which is equivalent to 5.74 lb. per 1,000 cu. ft. of filter. When loadings exceed this figure, filters may still be operated as roughing filters to be followed by other methods of treatment, or the loading may be reduced by more effi-

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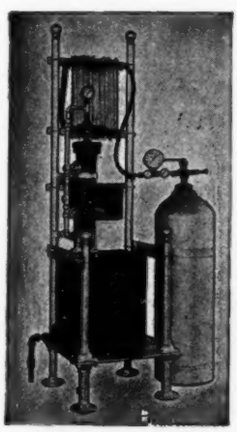

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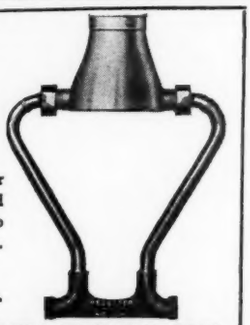

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cient removal of suspended solids. These conclusions were based on studies of the actual operation of eight plants serving from 8,000 to 260,000 population.[C20]

Chlorinating activated sludge at Marlboro hospital, N. J., a 1.3 mgd plant, with a view to controlling bulking, with chlorine dosages ranging from 3 to 72% of the chlorine demand, or 0.01 to 0.46% on the dry solids basis, had no effect either in reducing the numbers of filamentous organisms or in changing the settling character of the activated sludge floc; purification of the sewage liquor was practically unaffected by the chlorine; but the chlorine demand of the sludge decreased continuously during the period of chlorination—2½ months.[C21]

Sludge as fertilizer was discussed by the Institute of Sewage Purification (England). Rudolph Anstead, speaking as a biologist, said sludge should be so used as a matter of national conservation. Others believed cities should not tax their citizens to produce fertilizers for others. In a number of cities, however, the fertilizer was sold at cost or more. Maidenhead and South Norwood composted the sludge with household refuse (including garbage). In the latter 100 tons of pulverized refuse was dumped into a lagoon holding 150 tons of wet sludge, which settled to 125 tons of combined compost of 50% to 60% moisture, and was sold at a loss. Maidenhead sold its compost at a profit, getting $1.25 a ton at the plant. Glasgow could not sell its fertilizer. Bradford sold all its press cake for fertilizer. Manchester, Birmingham and Kingston also sold their sludge; the last had requests from the continent for hundreds of tons.[D6]

Rainfall intensities and frequencies, including only excessive storms having durations of 120 min. and less, were studied by the statistical method, and conclusions reached were: That such a method which combines station-years affords a means for studying rainfall data which gives reasonably regular and consistent results; semi-logarithmic and hyperbolic papers are effective tools in such studies. For the shorter durations, the inlet time is an important factor in the time of concentration. Apparently when the durations are in a geometrical series the differences in rainfall values are a constant. When frequencies are in a geometrical series the differences in durations for a given intensity are constant. The ratio of the average intensity over a large area to the maximum on that area is unknown and needs investigation. A study should be made of the relation of average intensities to maximum intensities of rainfall on small areas such as may be used in sewer design, say up to 10,000 acres.[K2]

A rotary distributor installation, the largest to date, forms part of a plant for Dayton, O., now nearing completion as a WPA project. There are twenty filters, each 165 ft. diameter and 7½ ft. average depth. The filtering material will be slag; stone was planned for the bottom 2/3, but no local stone would meet the 20-cycle sodium sulphate test for soundness. The influent conduit to filters will be provided with a ¼ in. mesh screen. Valves on inlet and outlet will permit flooding for fly control. There are four final settling tanks, 80 ft. diameter and 9 ft. deep at side walls, providing 1½ hr. detention at average rates, with peripheral weirs and mechanical sludge removers. Hand labor made 800,000 underdrainage blocks of concrete, the blocks being 2 x 3⅝ x 21 ins.[C22]

Sewerage advances recently have been chiefly in the design of storm water conduits, pumps and pumping stations, and flow-measuring devices. The last includes the venturi flume, Parshall flume, and Sutro weir. Much remains to be done to protect concrete from hydrogen sulphide gas; possibly lining it with synthetic resins, or manufacture of a cement more resistant to this than any portland cement yet available.[65]

Bibliography of Recent Sewerage Literature

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

C — *Sewage Works Journal*

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14. Observations on Digestion of a Sewage Sludge Over a Wide Range of Temperatures. By G. M. Fair and E. W. Moore, pp. 3-5.
15. The Elutriation of Digested Sludge. By C. E. Keefer and H. Kratz, Jr., pp. 6-11.
16. *t.* The Oxygen Demand of Mixtures of Activated Sludge and Sewage. By E. W. Moore, pp. 12-21.
17. *t.* Chemical Coagulation of Sewage: Clarifying Value of Return Sludge. By W. Rudolfs and H. W. Gehm, pp. 22-33.
18. *t.* Influence of Phosphorus and Nitrogen on B. O. D. By W. L. Lea and M. S. Nichols, pp. 34-40.
19. Comparison of Sewage Purification by Compressed Air and Mechanically Aerated Activated Sludge. By G. M. Ridenour and C. N. Henderson, pp. 41-49.
20. Trickling Filter Loadings. By G. A. Hall, pp. 50-62.
21. Operation Experiences with Chlorination of Activated Sludge. By G. M. Ridenour, C. N. Henderson and H. B. Schulhoff, pp. 63-69.
22. Sewage Plant Construction with W. P. A. Labor. By M. W. Tatlock, pp. 70-79.
23. The Geneva, N. Y., Sewage Treatment Plant. By E. A. Marshall, pp. 80-84.
24. Problems in Sewage Treatment at State Institutions. By C. W. McBreen, pp. 85-90.
25. Improvements in Trickling Filters. By K. Imhoff, pp. 91-92.
26. Gadget Contests. By W. D. Hatfield, pp. 93-99.

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14. *p.* The Wyke Beck Valley Main Sewer. By C. Cobbett, pp. 97-98.

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15. Sewage Disposal in 1936, pp. 136-143.
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17. *p.* Separation and Treatment of Storm Water Sewage. By H. H. Stanbridge, pp. 245-247.

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5. Sewerage and Sewage Treatment in Review. By C. G. Hyde, pp. 33-39.
6. "Dry Cleaning" Air Diffuser Plates. By A. M. Rawn, pp. 44.
7. Effect of Activated Carbon on Sludge Digestion. By C. E. Keefer and H. Kratz, Jr., pp. 56-57.
8. *p.* Sewage Treatment Designed to Handle Industry's Wastes. By C. C. Hommon, pp. 64-66.
9. Phoenix Sewage Plant Gets Much Needed Detritor. By D. Travaini, pp. 67-68.

H — *Municipal Sanitation*

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30. St. Louis Discharges Ground Garbage Into Mississippi River. By F. J. McDevitt, pp. 126-128.
31. Recent Developments in Air Diffusion. By F. C. Roe, pp. 129-131.
32. Incinerator Supplies Power for Sewage Plant, pp. 132-133.
33. Stainless Steel in Sewage Treatment. By C. C. Snyder, pp. 134-135.
34. *n.* Grand Rapids Sewage Works Finds Steady Demand for Fertilizer, p. 141.
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1. *c.* New Sewer System at Corpus Christi, Texas, pp. 19-20, 34.

J — *American City*

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13. Incinerator Furnishes Power for Sewage Plant, pp. 28-29.
14. *n.* Winter Operation of Sewage Plants, p. 29.

S — *Construction Methods and Equipment*

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1. *c.* Constructing New Storm Sewer in Massillon, O. pp. 48-50.

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When writing, we will appreciate your mentioning PUBLIC WORKS.

Following is a digest of the important articles published last month having to do with water works design, construcion and operation and water purification, arranged in easy reference form.

The Water Wheel

Cleaning filter sand with acids was studied at Chapel Hill, N. C., to compare the cleaning efficiencies of caustic soda, sulphuric acid, hydrochloric acid, nitric acid, chlorinated lime and soda ash; determine the strength of chemical solution and period of contact with the sand that gave the best results; and the best method of applying the solution. Used with Chapel Hill water, sulphuric acid was found to have the highest cleaning efficiency, cost least, cleaning with it would keep a bed out of service not more than an hour, completely removing the sand grain coatings without damaging silica sand. Unfavorable factors were danger of corrosion of metal parts of the filter and of damage to the concrete filter box. "Experiments with a 2 ft. diameter filter indicate that penetration of acid into the bed takes place most slowly when the water level is drawn below the sand surface and the acid sprayed on the bed. The sand should be raked, following application of the acid, to break up mud balls and to bring the chemical into contact with all the grains near the surface." Further investigation is needed of protection of underdrains and filter box from acid, and full-scale demonstration of the practicability of using strong acid solutions for short contact periods.[F26]

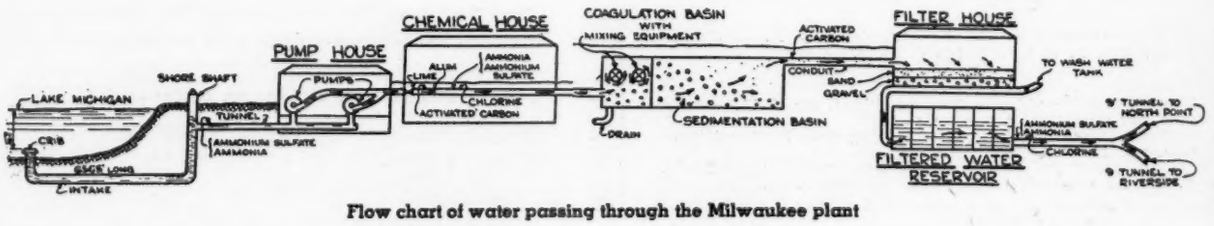
Milwaukee filtration plant of 200 mgd. capacity, now under construction, contain low-lift pumps raising lake water 30 ft. to 4 coagulation basins. It passes through plant by gravity and to present pumping stations, with five new pumps of 275 mgd. combined capacity, driven by 2300 volt synchronous motors. Two 20 mgd. wash water pumps discharge into a 750,000 gal. concrete wash water tank. All suction and discharge pipes have butterfly valves. Four-hour settling in two-story coagulation basins. Thirty-two 45 x 57 filter beds, central gullet type, 4″ cast iron undergrains; 24″ of gravel, 5″ of torpedo sand, 22″ of sand 0.45 to 0.50 mm.; wash water troughs 27″ above sand. Clear well under filter beds, 13 mg. capacity, connected to 2 filtered water reservoirs of 17 mg. combined capacity. Chemicals handled in bulk form, raised by airveyor to overhead steel storage bins. Ammonia or ammonium sulphate applied either in raw water tunnel to pump house, raw water lines to coagulation basins, or to filter effluent. Alum or lime applied to lines leading to mixing basins. Activated carbon applied to lines leading to mixing basins or settled water conduits leading to filters. Connections provide both pre- and post-chlorination.[F28]

Filter washing at Denver's west side plant at the rate of 70 cfs (36″ rise) exceeded capacity of outlet ditch to remove it, so water is discharged into a basin 50′ square by 12′ deep, holding two filter washes. During the summer this water is discharged into an agricultural ditch and used for irrigation; during the winter it is pumped back to the mixing basin and goes through the plant.[A20]

Coagulants should be mixed with water more slowly and for a longer time in winter than in summer, requiring 2 to 3 times as large a mixing chamber; obtained in the case of baffle chambers by installing take-off gates at quarter points or other fractional division. If mechanical mixing is employed, there should be a number of units, one or more of which can be cut out in winter. "Flexibility in this important step of coagulation is usually neglected and there is great need in most plants for careful consideration in design."[A27]

Coli-aerogenes from wild animals upon a water shed is possible. Droppings from bear, birds, woodchuck and porcupine in a wild habitat give positive tests; beaver, deer, elk, gopher, moose, prairie dog and rabbit did not, but the latter list if in captivity or mingling with domestic stock, and fish in a contaminated stream, gave positive reactions.[A47]

Odor elimination from Chicago's Lake Michigan water by laboratory tests of activated carbon, superchlorination and dechlorination, ozone treatment, ammonia-chlorine treatment, and aeration, "correct for the particular water used in the test at the time and in the manner conducted," showed that, to reduce the odor to a threshold of 2 at 70°C (at which it is doubtful whether any odor will be detected by the consumer), activated carbon treatment would probably be selected; also that a combination of superchlorination and filtration or one of the other treatments would materially reduce the amount of odor to be removed by carbon and reduce the total cost. Using hot threshold odors, a raw water of about 18 was reduced to 10 by 3 ppm. of activated carbon, to 6 by 6 ppm. to 4 by 9 ppm., to 2.5 by 12 ppm., and to 2 by 15 ppm. Using ozone, reduction to 10 was secured after three hours contact. Chloramine at its optimum dose rate gave a reduction to 15.5. Super- and de-chlorination, using 6 ppm., gave a reduction to 12. The best result obtained by aeration was about 13. Rapid sand filtration reduced the threshold number



Flow chart of water passing through the Milwaukee plant

CLEVELAND comes back for more!

Dresser Couplings are making a hit in Cleveland! Used in 1934 on a 30" water line, Dresser Couplings were called for again on another 30" steel supply line, constructed in 1936. That's the way it is everywhere! Once tried, Dresser Couplings stay on call.

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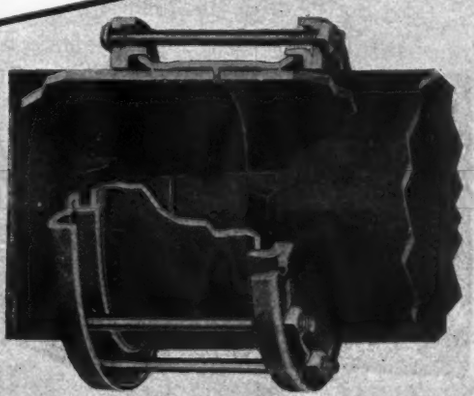
Ordinary workmen completing Dresser joint in Cleveland 30" supply main, built in 1936.



Cutaway view of Dresser Style 38 Coupling, showing working principle. Plain-end pipe is used. The resilient gaskets flexing with the pipe, safely absorb pipe movements.

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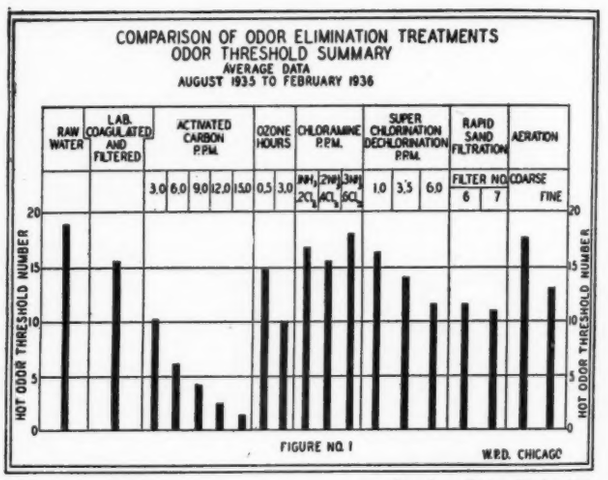
to about 11.5. It may not be essential to use expensive treatment to reduce the threshold to 2, but it should be brought as near this as reasonable cost will permit.[A45]

Tastes and odors at Culver City, Calif., due to iron and sulphur bacteria in the ground water supply of 1.25 mgd., were removed by means of three pressure filters containing 42″ of granular activated carbon on 3″ of filter sand, resting on several layers of graded gravel surrounding a standard strainer system. Filter rate, 3½ gpm. per sq. ft., of surface; backwashing rate 12 gpm. per sq. ft. Water prechlorinated, with 0.5 ppm. of residual chlorine at filter inlet. Effluent was clear and devoid of taste. After 4 months, insufficient backwashing and some oil caused trouble, removed by air washing; since which air has been used regularly in backwashing. After two years of hard service the carbon was found to have lost about 50% of its effectiveness. Cost of installation $10,000, $2,800 of this for the carbon. Cost of carbon calculated to be $3.10 per mg.[A46]



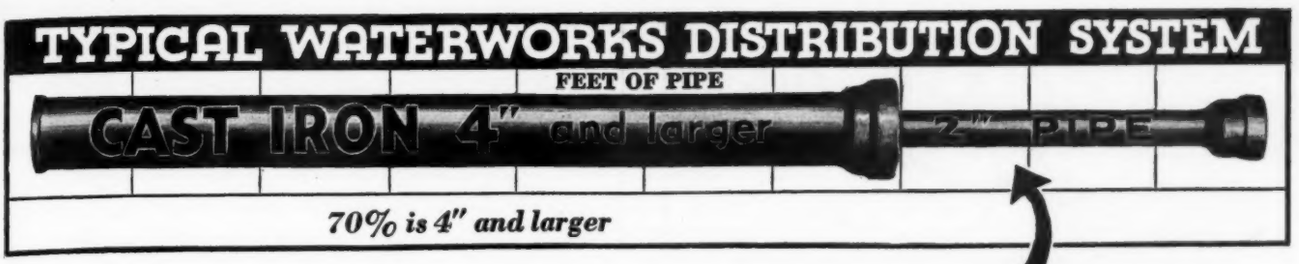
American Water Works Assn.

Comparison of various odor elimination treatments

Fluoride can be reduced to 1.0 ppm. by overtreatment with lime to a causticity of about 2 grains per gallon, in the presence of sufficient magnesium, between the limits of 1.5 and 3.5 ppm. fluoride; removal of fluoride varying as the square root of the removal of magnesium. Water softening plants of the standard type are adaptable to this treatment. For villages of 1,000 population construction cost of lime softening-fluoride reduction plant is about $10,000; operating cost about equals that of standard water softening, plus addition of magnesium if necessary.[A38]

Conduit sizes and slopes giving maximum economy, where tunnels, surface conduits, pumping, etc., are combined (as in the Colorado river aqueduct), and head is useful for creating power, can be determined by more or less complicated formulas, curves and trial values. If length of tunnel decreases with height of dam above it, there will be a dam height giving minimum combined cost; increasing grade of tunnel generally increases length, but decreases size, and a certain grade gives minimum cost. The method used in solving such a problem in designing the Colorado river aqueduct is described by the assistant chief engineer.[E7]

Gate valves of 16″ diam. or larger are found difficult to operate in Milwaukee at 100 lb. pressure if there is no bypass. For smaller valves with lower pressure, no bypass is necessary.[A40]



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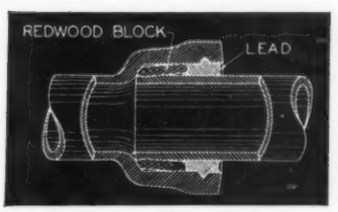

Here is the simple, self-tightening Precalked Joint that has made McWane 2" Cast Iron Pipe standard from coast to coast. The Precalked materials are already in the bell. Just socket the spigot and calk.

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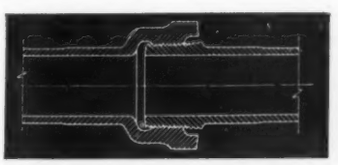

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Gravel well screens should be made of the very best grade of non-corrosive metals, such as silicon-manganese-bronze or the various stainless steels. Cast iron or concrete can be used in shallow wells. Iron other than stainless steels should not be used where carbon dioxide, dissolved oxygen, sulphuretted hydrogen, or other corrosive materials are present in the water in any appreciable quantities. Composition metals, even though largely copper, may create electrolytic action on well casing or pumping equipment unless the materials are properly balanced. Material containing 90 to 94% copper, the balance silicon and manganese, is probably one of the best to use for screens under nearly all conditions with the possible exception of water containing sulphur, where stainless steel may prove superior.[A50]

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c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract) *t*, technical article.

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Fig. 67

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56. Experiments with Sub-surface Filters at Toledo, O. By R. W. Furman, pp. 194-200.
57. How Much Water Do We Consume? How Much Do We Pay for It? By C. H. Capen Jr., pp. 201-212.
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13. Reservoir Construction Effects Saving in Purification Costs. (Cheraw, S. C.) By J. D. Smith, p. 25.
14. An Unusual Experience in a Chlorinating Plant. By R. E. Phaneuf, p. 25-26.
15. Selling Water Softening to the Voters, p. 26.
16. *n.* Easement for a Water Pipe Line Does Not Include Duplicating It, p. 26.

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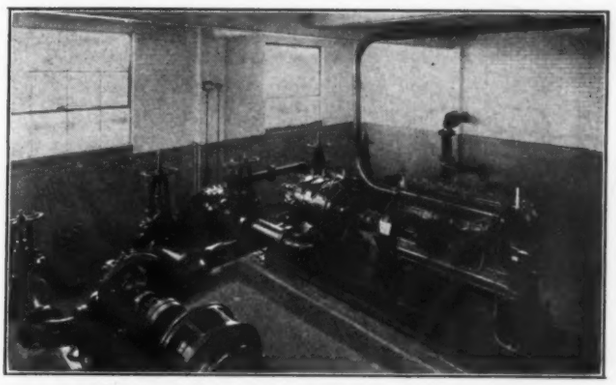

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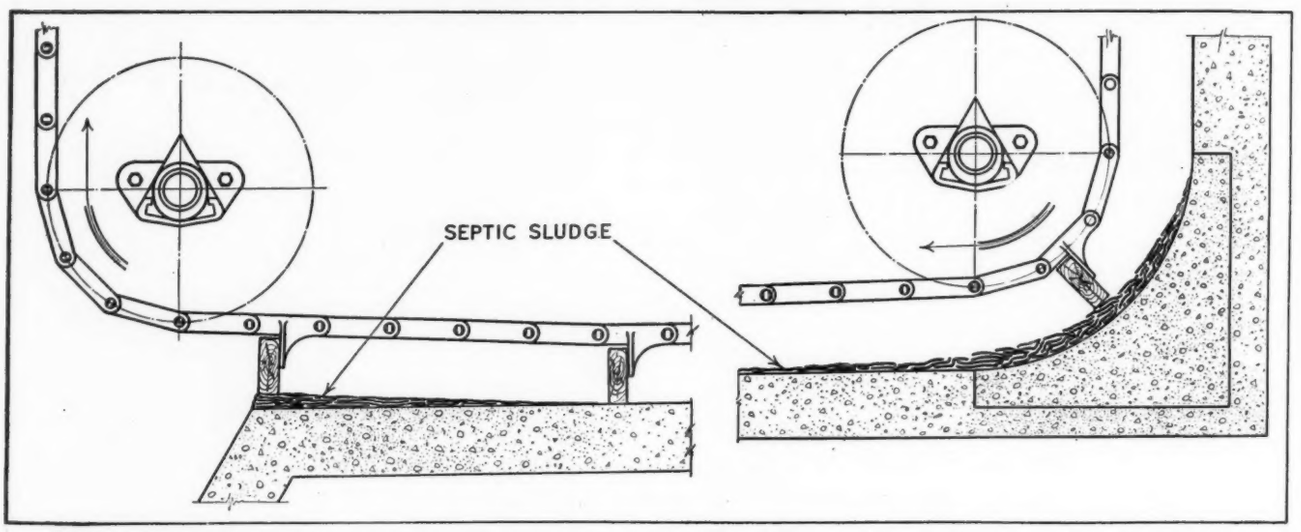
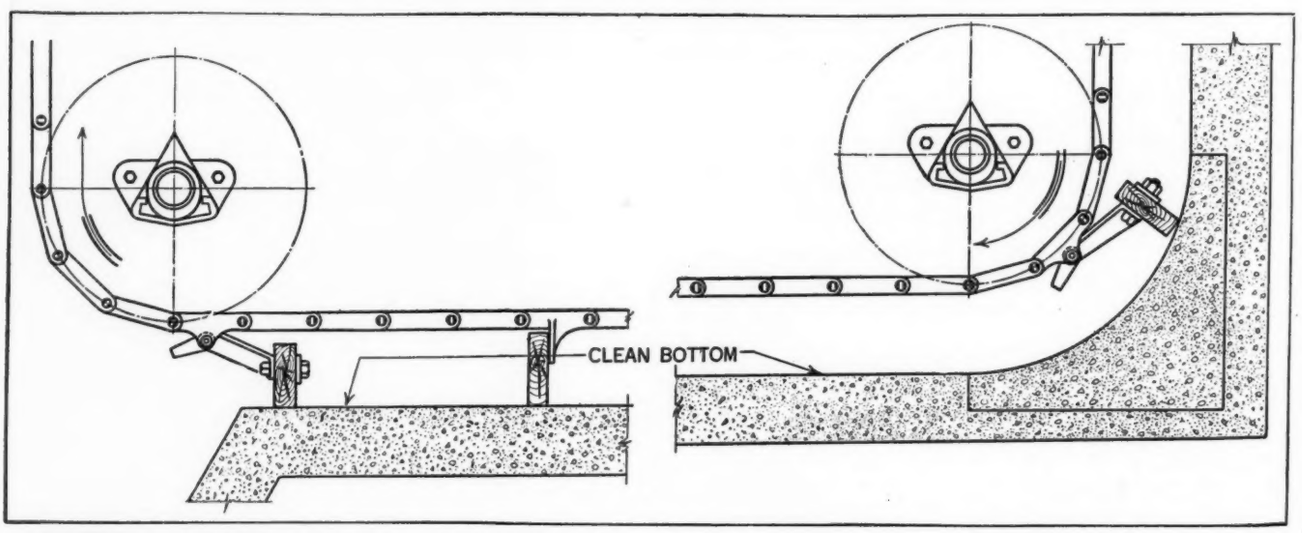
The PIVOTED Flight

A FEATURE OF THE LINK-BELT STRAIGHTLINE COLLECTOR WHICH ASSURES COMPLETE SLUDGE REMOVAL



RIGID FLIGHTS. This drawing shows the sludge left in the settling tank by rigid flights. Clearance, which must be provided under sprocket wheels, increases as flights wear, permitting an accumulation of septic sludge.



PIVOTED FLIGHTS. Link-Belt pivoted flights follow the contour of the tank, assuring positive cleaning of corner turns and floor, regardless of clearances or wear of flights.

Greater efficiency is obtained by the use of pivoted flights because they remove all of the sludge from the bottom of the tank. Only two pivoted flights are required on each collector to clean up. The additional cost of pivoted flights is negligible.

High efficiency, positive results, large capacity and low first-cost, with small maintenance and power expense, are some reasons for the popularity of the Link-Belt Straightline Sludge Collector. Send for Book No. 1542. Link-Belt Company, Philadelphia, Chicago, Los Angeles, Atlanta, or Toronto.

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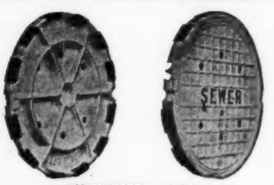

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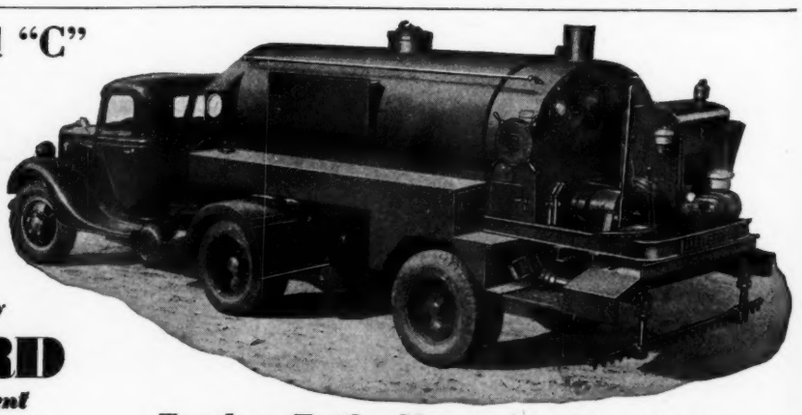

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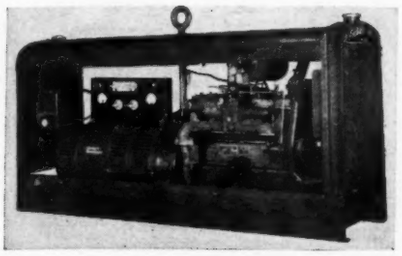
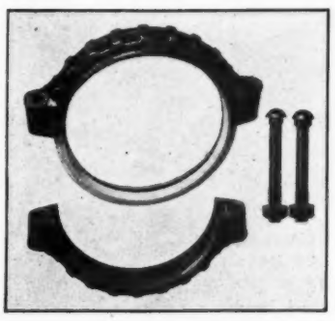


The Hobart electric pipe thawer is specially designed for thawing frozen water pipes. It is not adaptable for other purposes. Weighs about 1700 lbs. for truck use. Hobart Bros., Troy, O. Excellent booklet on request.

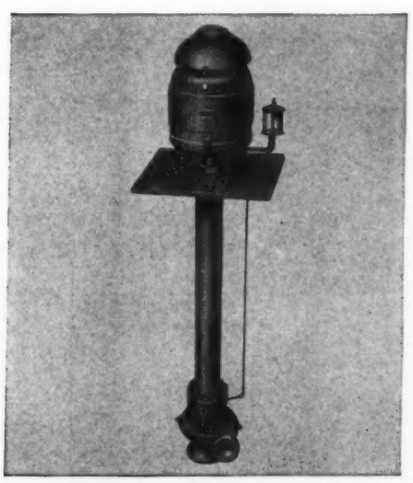


Victaulic Co. of America, 26 Broadway, N. Y., has published a new catalog (37-8) on Victaulic pipe couplings for use with steel, w. i., or c. i. pipe. Data and illustrations sent on request. A Victaulic Coupling is shown above.

Saylor-Beall Mfg. Co., Detroit, Mich., make this paint spray gun, which is suitable for repainting hydrants, traffic signs, equipment, bridges and buildings. Atomizes internally or externally. Outfit includes compressor, hose and gun.

The P & H gas-driven welder is shown above, mounted on an old model light truck. Furnished by Harnischfeger Corp., Milwaukee, Wisc. Full data on request.

P & H "455" 1-yd. excavator, mounted on crawlers. The use of special steels permit a very light weight; crawler by Allis-Chalmers; full information from Harnischfeger Corp., Milwaukee, Wis.



"Freflo" centrifugal pump, made by Worthington Pump and Machinery Corp., Harrison, N. J., is especially adapted to underpass drainage, or for any similar pumping work. Capacity 85 to 7500 gpm. Bulletin on request.

PERSONALS

Olney Borden, formerly WPA engineer for Sullivan County, N. Y., has been made county WPA director.

W. H. Hampton and D. R. Sanders are the founders of Indiana Toncan Culvert Co., 802 Inland Bldg., Indianapolis, Ind., which will handle Toncan products in Indiana.

J. L. McCaffrey has been promoted to be director of domestic and Canadian sales of the International Harvester Co. W. F. McAfee succeeds Mr. McCaffrey as manager of domestic sales; and P. V. Moulter succeeds Mr. McAfee as manager of Domestic truck sales.

A. W. Daniels has been elected president of the Universal Crusher Co. and H. F. Rikhoff secretary and treasurer. L. S. Hackney is sales manager and L. W. Dunlap assistant general manager.

H. B. Loxterman has been elected vice-president of Blaw-Knox Co., and Albert L. Cuff secretary.

R. B. Renner, who has been with the Jeffrey Mfg. Co. for 30 years, has been made chairman of the executive committee of the Materials Handling Division of the American Society of Mechanical Engineers.

American Water Works Association

The nominating committee of the American Water Works Association has selected the following nominees for 1937-8: President, Eugene F. Dugger, general manager, Newport News Waterworks Commission, Newport News, Va. For treasurer, W. W. Brush, editor of Waterworks Engineering, New York.

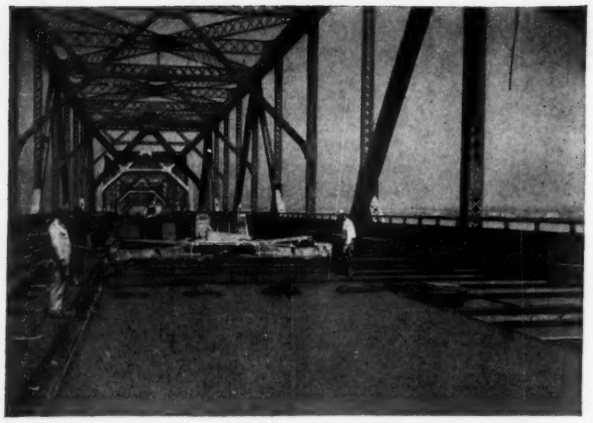
Thomas Brooks of the Los Angeles Water Department, Mr. Brush, Ross L. Dobbin of the Peterborough, Ont., Utilities Commission, and William L. Rapp, of the Atlanta, Ga., Water Department, were elected to honorary membership at the meeting of the Board of Directors held in January.

The John M. Goodell prize for 1937 was awarded jointly to Harry Hayes of the Bureau of Water Works and Supply, Los Angeles, for his paper "Laboratory Control of Protective Treatment for Steel Pipe Lines by the Bureau of Water Supply of Los Angeles;" and to Laurance E. Goit, of the same organization, for his paper on "Steel Pipe Cleaning and Coating Plant of the Bureau of Water Works and Supply of Los Angeles."

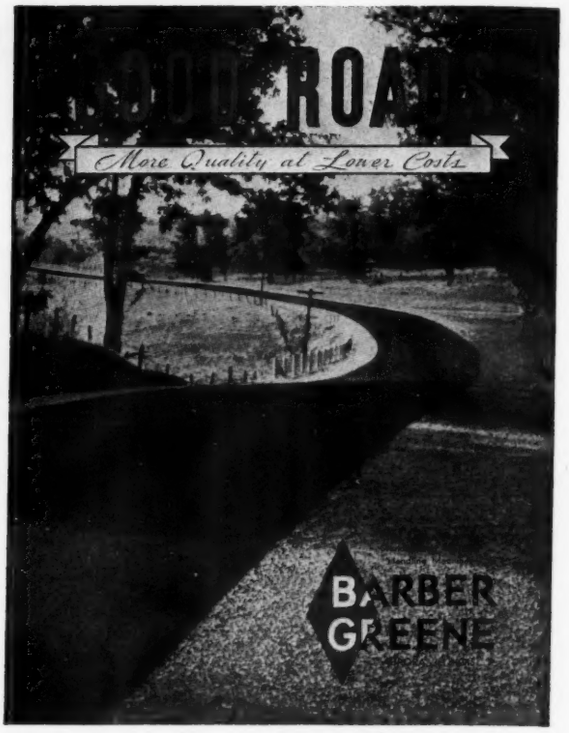
The 1937 meeting of the association will be held in Buffalo, N. Y., June 7 to 11.

Jersey Sewage Works Association

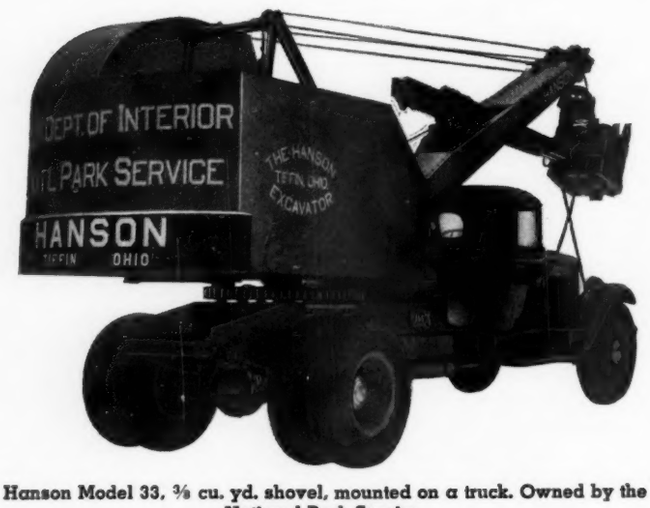
The 22nd Annual Meeting of the New Jersey Sewage Works Association will be held March 11th and 12th, at the Stacy-Trent Hotel, Trenton, N. J.



The Hercules-powered, Jaeger-Lakewood finishing machine, shown here, was used by the Bates & Rogers Construction Company of San Francisco in paving the roadways on the San Francisco-Oakland Bay Bridge. A roadway 58 feet wide and 4.1 miles long was laid on the upper deck, while the lower deck roadway consists of a 31-foot strip 3.9 miles long.



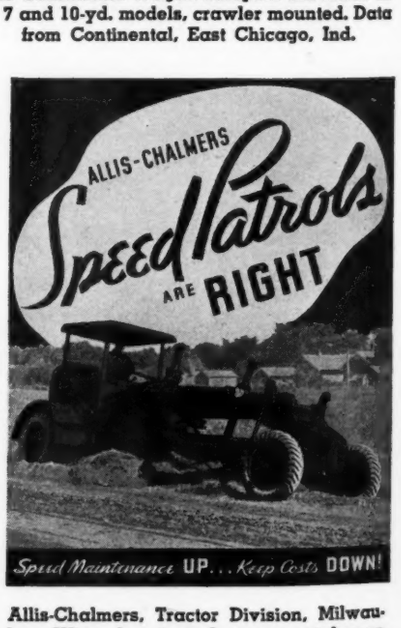
Cover of a complete catalog issued by Barber-Greene, Aurora, Ill. Contains much good roads data; 52 pp., very well illustrated; sent on request.



Hanson Model 33, ⅜ cu. yd. shovel, mounted on a truck. Owned by the National Park Service.

The Continental Wagon Scrapers are made in 5, 7 and 10-yd. models, crawler mounted. Data from Continental, East Chicago, Ind.

Caterpillar diesel RD7 tractor and power controlled blade grader on road construction in Illinois.



Allis-Chalmers, Tractor Division, Milwaukee, Wisc., has issued a new catalog on their Speed Patrols for highway work. Copies from above or at any Allis-Chalmers dealers or branches.

Descriptions of these free booklets are published to help you obtain needed information quickly

Readers' Service Department

Mail the Coupon for Any of These FREE Booklets When You Need Information

ALSO SEE OTHER DESCRIPTIONS ON PAGES 56 AND 57

Construction Materials and Equipment

Asphalt Heaters

9. Illustrated manual No. 11 describes "Hotstuf," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Black and White Prints

14. Illustrated booklet "Black and White Magic" shows how to make Black and White Prints (back-line prints) without the use of a negative and faster than blue prints. Booklet gives full information about the BW Direct Printing Process and its application. Charles Bruning Co., Inc., 102 Reade Street, New York, N. Y.

Concrete

28. "Better Concrete" sums up good concrete construction practice for the benefit of the man on the job, illustrating every step in the making of concrete with instructive and excellent photographic views. Also, how "Incor" 24-hour cement makes it easy to get good concrete at lower cost. This is a worth-while book. Write "Incor" Cement, Room 2208, 342 Madison Ave., New York, N. Y.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subject suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 61 Broadway, N. Y. C. useful tables.

36. "Wyandotte Calcium Chloride and its use in Portland Cement Concrete," a booklet covering the subject of curing concrete pavements, structures, etc., giving complete specifications for surface and integral curing. Published by the Michigan Alkali Co., 60 East 42d St., New York, N. Y.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size, The Jaeger Machine Company, Columbus, Ohio.

Concrete, Vibrated

50. Data on methods and equipment for, and the results obtained from the use of, vibrating equipment on thin walls, pavements, culverts, bridges, floors and other concrete construction. Munsell Concrete Vibrators, Teaneck, N. J.

51. How to use concrete vibrators to make better concrete in either large masses, thin walls or any other type of concrete structure. Also new illustrated catalog issued by Mall Tool Co., 7745 So. Chicago Ave., Chicago, Ill.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts.

Distributors

70. Full facts about the new Etnyre models "FC," "FX" & "MX" bituminous distributors—why Etnyre is the most widely used bituminous distributor in the world. Get catalogs 506B and 507B. Issued by E. D. Etnyre & Co., Oregon, Ill.

71. A handsome 14 page catalog, well illustrated in colors, tells how the 3 big features of the Littleford "Model C" pressure distributor work and why this machine is called, "everything you have ever wanted in a distributor." Your copy will be sent on request. Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

Stone and Gravel Crusher

76. Illustrated bulletin gives full specifications of Gruendler portable and stationary rock and gravel crushing and screening equipment in sizes from 100 tons to 1,500 tons daily capacity. Gruendler Crusher and Pulverizer Co., 2,917 North Market St., St. Louis, Mo.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1248, 1298 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, 307 No. Michigan Ave., Chicago, Ill.

Motor Trucks

105. "What is Quality in a Motor Truck," is a new booklet containing valuable information for the prospective buyer of motor trucks. While this booklet refers especially to 1½ to 2-ton trucks, many of the facts contained in it are also applicable to heavy-duty units. Sent free on request by International Harvester Co., 606 South Michigan Ave., Chicago, Ill.

Mud-Jack Method

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost and time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials

109. The maintenance of all types of roads, streets, and pavements is fully described in the 52 pages of a new booklet, just issued by The Barrett Company, 40 Rector St., New York, N. Y.

Each step in the various processes is given in detail and illustrated with photographs of actual operations.

112. Complete directions for surface treatment and bituminous surfacing with Cut Back Asphalt are contained in a 36 page data book, Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

113. How to stop skidding effectively at the danger spots through the use of Alundum (C.F.) Aggregate is the subject of an interesting new leaflet just issued by the Norton Company, Worcester, Mass.

Pumps

121. New catalog and new low prices of Jaeger sure prime pumps, 2" to 6" sizes, just issued by Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio.

Road Building and Maintenance

125. "See Koehring on the Job," the new Koehring pictorial presentation contains more than 100 interesting construction pictures you will want for your reference file. Sent free on request. Koehring Co., 3026 West Concordia Ave., Milwaukee, Wis.

126. Action pictures show steps in road construction and maintenance, covering grading and ditching, rough grading, gravel and stone road construction, bituminous surfacing, fine grading and paving, summer and winter maintenance, municipal work and material handling, and illustrate Austin-Western equipment on such work. Ask for publication 1475 Austin-Weston Road Machinery Co., Aurora, Ill.

127. A new series of bulletins on road building and maintenance equipment have just been issued by Galion Iron Works & Mfg. Co., Galion, Ohio. These illustrate and give full information regarding their new variable weight Tandem Roller, Leaning Wheel Grader, Diesel Powered Motor Grader, Portable Roller and Chief Roller with "Roll-A-Plane" attachment.

129. Illustrated pamphlet shows how the Parsons Turbo saves handling, power, time and expense in mixing any road materials with every kind of commercial binder in place on the road. Sent promptly by The Parsons Co., Newton, Iowa.

Rollers

132. The NEW Buffalo - Springfield Special Three-Axle Rollers for all kinds of precision rolling, especially of bituminous materials either hot or cold, are described in an illustrated pamphlet just issued by the Buffalo-Springfield Roller Co., Springfield, Ohio.

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CONTINUED FROM PAGE 55

Rollers, Light

133. New Tu-Ton roller of simple construction for use in rolling sidewalks along highways, playgrounds and other types of light rolling is fully described in a bulletin issued by C. H. & E. Mfg. Co., 3846 Palmer St., Milwaukee, Wis.

Safety Signals

137. Complete details concerning the new, troubleproof "Auto-Flex" sign easels and barricade supports, which do not blow down, will be sent promptly by National Safety Hiwa Equipment Co., Palmyra, Mo.

138. New bulletin describes the Martindale Barricade, Tripod and Drive type safety signals which dominate their surroundings with a flashing contrast of brilliant colors. Illustrates wide variety of stock lettering. Sent promptly by Martindale Electric Co., 1378 Hird Ave., Cleveland, Ohio.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Scrapers

142. Introducing Model "U" LeTourneau Carryall Scrapers, increasing earth-moving capacity 50 percent. Sizes 18, 12, 9 and 6 yards. New literature just issued by R. G. LeTourneau, Inc., Peoria, Ill.

Shovels, Cranes and Excavators

143. "Loads Lifted" gives pictures, facts and figures on LeTourneau Tractor Cranes used for steel erection, pavement breaking, industrial hoisting, construction, etc. Write for a copy. R. G. LeTourneau, Inc., Peoria, Ill.

144. Bucyrus-Erie Company will send you on request a new pictorial presentation of their new ⅝ yard power shovel . . . "modern in appearance, modern in design, modern in performance." Bucyrus-Erie Company, Publicity Dept., So. Milwaukee, Wis.

145. The Austin Badger, a new, fully convertible ⅝ yard crawler shovel, made by The Austin-Western Road Machinery Co., No. A-5 Aurora, Ill., is fully described and illustrated in their Bulletin No. 1236.

Spreader

147. The Jaeger *Adjustable* Spreader for smoothly spreading stone, macadam and bituminous—1" to 7" thickness, 8 to 11 ft. width is described and illustrated in a new catalog now ready for distribution. Issued by Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio.

Soil Stabilization

150. Explicit Instructions for testing soils and constructing and maintaining low-cost stabilized roads are contained in two excellent new booklets. No. 1 contains brief specifications for construction. No. 3 makes clear the procedure in sampling and calculating mixtures. Both are well illustrated with tables of useful information, charts and photographs. Just published by Solvay Sales Corp., 61 Broadway, New York, N. Y.

151. Full information and details regarding gravel-clay stabilized roads and the Pioneer portable stabilizer plant can be obtained from the Pioneer Gravel Equipment Mfg. Co., 1527 Central Ave., N. E., Minneapolis, Minn.

152. The Columbia Alkali Corporation, Barberton, Ohio, will be glad to furnish to anyone interested complete information dealing with Calcium Chloride Stabilized Roads. This literature contains many charts, tables and useful information and can be obtained by writing The Columbia Alkali Corporation, Barberton, Ohio.

Tires, Truck and Tractor

165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tractors—Diesel and Gasoline

185. The various applications of Cleveland tractors to economical grading, road maintenance, bull-dozing, dirt moving, pipe handling and other work are illustrated in a booklet issued by Cleveland Tractor Co., Cleveland, O.

186. The new A-C *controlled ignition* oil tractor, the first tractor to combine gasoline engine simplicity and smoothness with fuel oil economy, is described in an illustrated bulletin recently issued by Tractor Division, Allis Chalmers Mfg. Co., Milwaukee, Wis.

Snow Removal

347. The new Barber-Greene Snow Loader for fast and efficient snow removal is described in a 24 page catalog which also contains a lot of valuable information on organization for snow removal. Barber-Greene Company, 635 West Park Ave., Aurora, Ill.

348. Illustrated circular describes a handy, power-driven, sidewalk snow plow which many communities are finding very useful. Mower can be substituted for plow in the spring. Write Gravely Motor Plow & Cultivator Co., Box 894, Dunbar, West Va.

349. "V Type Sno-Plows for Every Size Motor Truck" describes and illustrates all features of the Frink V type plow, including the new power hydraulic control as well as the earlier types of lifting devices. Also describes and illustrates 14 styles of leveling wings and the different attachments which may be used in connection with them. Just issued by Carl H. Frink, Mfr., Clayton, N. Y.

350. New 62 page booklet, complete catalog and handbook No. 101, indispensable to street and highway officials, explains and illustrates their newest snow plow models for the 1936-1937 season. Sent on request by the Good Roads Machinery Corporation, Kennett Sq., Pa.

351. Literature just issued by the Parsons Company, Newton, Iowa, describes and illustrates their fast, sturdy One-way plows, Vee Plows and Wings for both large and small trucks.

352. Willett Mfg. Corp., Plymouth, Ind., has new literature describing and illustrating their quality-built Willett snowplows of which they make a complete line for all trucks, Vees being interchangeable with One-ways.

355. "Make Icy Pavements Safe With Rock Salt" is an authoritative booklet describing one of the most effective and economical methods of winter ice control. International Salt Co., Scranton, Pa.

Street and Paving Construction

Dust Control

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Just issued by Dow Chemical Co., Midland, Mich.

211. A complete booklet on dust control titled, "Dust Control and Road Stabilization," describes the use of Columbia Calcium Chloride for dust control purposes and stabilization of roads. Sent on request by The Columbia Alkali Corp., Barberton, Ohio.

Bituminous Materials

227. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvia-lithic, 32 excellent illustrations.

229. A new series of concise and authoritative manuals of construction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Avenue, New York, N. Y.

229A. Surface Treatment Types Asphalt Road Construction Manual No. 2. Full details on surface treatments. 14 chapters, 128 pages. The second of those tremendously valuable and handy little manuals put out by the Asphalt Institute, 801 Second Avenue, N. Y. Sent on request.

Brick Paving

230. Recommended standard specifications for vitrified brick pavements and brick parking strips and gutters, as submitted to the American Society of Municipal Engineers. If you contemplate using brick for paving, you should have a set. National Paving Brick Ass'n, Washington, D. C.

Gutters

240. "Brick Gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Jacking Culverts

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Traffic Markers

275. How the Littleford "Traf-O-Spray" puts down a clean-cut traffic mark on any type of pavement regardless of condition of surface, is explained and illustrated in a new bulletin issued by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

Sanitary Engineering

Activation and Aeration

375. This concise folder No. 1294 describes "Straightline Aerators" for activated sludge treatment; combines the best points of the two types used in English plants: 1, rapid circulation in the tanks; 2, exposure of large surfaces, hastened oxidation and bacteriological growth. Link-Belt Co., 307 N. Michigan Avenue, Chicago, Illinois.

380. A valuable booklet on porous plates and porous tubes. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Air for Agitation

381. Send for full data concerning R-C Rotary Positive Blowers which supply air for agitation economically. Roots-Connorsville Blower Corp., Connorsville, Ind.

Readers' Service Department

These booklets are FREE to readers of PUBLIC WORKS.

CONTINUED FROM PAGE 56

Clarifying Tanks

383. Laughlin Clarifying Tanks for the more complete removal of suspended solids from sewage and industrial wastes at lower cost are described in a new bulletin just issued by Filtration Equipment Co., 10 East 40th St., New York, N. Y.

Cast Iron Sewers

385. For use in wet ground to prevent infiltration, for crossing under railways and heavy duty highways, and for all other sewer construction where replacement, repairs or reconstruction would be costly, cast iron pipe is most economical. For details, specifications, etc., write Thomas F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Couplings for Pipe

386. This sixteen-page booklet is a reprint of a magazine article by a consulting engineer. It describes in detail the installation of a 42" water line; contains specific information regarding pipe joints, field organization, laying pipe, tests, back-filling, etc. Sent free by S. R. Dresser Manufacturing Company, Bradford, Pa.

Feeders, Chlorine and Chemical

387. For chlorinating small water supplies, swimming pools and other installations. Flow of water controls dosage of chlorine (or other chemicals) providing required dosages, which are immediately adjustable. Driving is started and stopped automatically. Send for newest literature. %Proportioneers%, 9 Codding St., Providence, R. I.

Fire Hydrants

388. Two new bulletins on M-H fire hydrants and fully bronze mounted gate valves are now ready. Contain full specifications and instructions for ordering, installing, repairing, lengthening and using. Write M. & H. Valve & Fitting Co., Anniston, Ala.

Gate Valves

390. 28 page catalog contains illustrations and complete specifications of M-H standard and extra heavy iron body gate valves, horizontal swing check valves, flanged fittings and flanges, etc. Sent promptly on request by M. & H. Valve & Fittings Co., Anniston, Ala.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. Data on cast iron pipe for water works systems, in sizes from 1¼ to 84 inches, including information on useful life, flow data, dimensions, etc., Thos. F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Pipe, 2-inch Cast Iron

407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe, Steel

408a. A very complete, 60 page, illustrated bulletin on spiral welded pipe including lots of useful engineering information, hydraulic data, flow charts, specifications, etc., issued by American Rolling Mill Co., Pipe Sales Div., 1101 Curtis St., Middletown, Ohio.

Pipe Forms

409. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints

410. New folder describes in detail a new type of pipe joint—the Dresser Compression Coupling, Style 65, which is compact and self contained, makes a permanently tight joint under all conditions and is installed on plain end pipe in a few seconds with only one tool, a wrench. Get your copy today. S. R. Dresser Mfg. Co., Bradford, Pa.

Pipe Joint Compound

411. A new bulletin has recently been issued giving full details concerning Tegul Mineralead, a quick-sealing, trouble-free compound for bell and spigot joints which permits immediate closing of the trenches. Write The Atlas Mineral Products Co. of Pa., Mertztown, Pa.

412. New plastic sewer pipe joint compound, Servitite, contains chemicals which positively prevent root growth and gives watertight joint. Get complete information from Servicised Products Corp., 6046 West 65 St., Chicago, Ill.

Taste and Odor Control

413. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

Pumps and Well Water Systems

414. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps, fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for these three descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office Memphis, Tenn.

Protective Pipe Coating

415. Coal-tar Pitch Enamels for exterior and interior linings for steel water lines; highly resistant to water absorption, soil acids and alkalis. Technical specifications for materials and their application will be sent on request. The Barrett Company, 40 Rector St., New York, N. Y.

Pumping Engines

417. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Run-off and Stream-Flow

420. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

421. The simple, automatic Laughlin self-cleaning, traveling screen is fully described in an interesting bulletin issued by Filtration Equipment Co., 10 East 40th St., New York, N. Y.

423. Be asurred of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago, Ill.

Setting and Testing Equipment for Water Meters

424. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co., Wabash, Ind.

Rainfall Measurement

429. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

430. Water Screen Book No. 1252, describes traveling water intake screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sludge Bed Glass Covers

432. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Elizabeth, N. J. offer A. I. A. File 101 SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Incineration

438. A multiple hearth furnace which meets the most exacting municipal sanitary requirements for the incineration of sewage sludge—produces a fine ash or partially dry sludge for fertilizer—is described and illustrated with drawings and photographs in bulletins issued by Nichols Engineering and Research Corp., 40 Wall St., New York, N. Y. Operation as well as installation data is given.

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Swimming Pool Equipment

444. Filters, chlorination, underwater lights and other supplies for swimming pools are very thoroughly described in literature and folders. Plans and layouts. Everson Filter Co., 625 W. Lake St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Treatment

448. New 31-page catalog covers complete conveying, screening and reduction machinery for water purification and sewage treatment; describes and illustrates the design features of Jeffrey self-cleaning bar screen, combined screen and grinder, sewage screenings grinder, grit washer, conveyor type and positive discharge sludge collectors and green garbage grinder—includes installation views. Catalog 615, Jeffrey Manufacturing Co., Columbus, Ohio.

450. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

452. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

453. How to avoid sludge and scum troubles in settling tanks explained in detail in Book No. 1542—has excellent drawings and photographs, also specifications. Most important are the carefully prepared capacity tables. Link-Belt Co., 307 N. Michigan Ave., Chicago, Illinois.

454. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 247 Park Ave., New York, N. Y.

Thawing Equipment

460. Complete details concerning this quick-acting, efficient, electric pipe thawer which sells for only $39.25 complete, will be sent promptly by Commonwealth Mfg. Corp., Dept. P-710, 3785 Beachmont Ave., Cincinnati, Ohio.

For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

Road Construction And Maintenance:

A 70-page handbook containing complete tables and useful general information relative to the use of Tarmac for road construction and maintenance, has just been issued for free distribution by Koppers Company's Tar and Chemical Division, Pittsburgh, Pa. The book also contains a discussion of methods and advantages of soil stabilization with Tarmac, condensed specifications for various methods of using road tars, and tables of data not previously issued in handbook form. There also is a list of other Koppers products for the highway and public works field such as crack filler, paving pitch, traffic marking paint, dampproofing and waterproofing materials, old style pitch and approved felt for roofing, kolineum, Grade 1 creosote, koleener, weed killers, disinfectants, municipal incinerators, Fast's couplings, fire hydrants, water works gate valves, dam gates, treated timber, American hammered piston rings, gas holders and welded and riveted pipe.

Public Health Service Publications:

Following are some of the PHS reprints issued during the period Jan.-June, 1936. Requests should be addressed to Surgeon General, U. S. Public Health Service, Washington, D. C.

1725. The typhoid control program and results of 13 years' work in Williamson County, Tennessee, 1922-35. By W. C. Williams and E. L. Bishop. January 3, 1936. 15 pages.

1726. City smoke and its effects. A statement prepared for the congressional Subcommittee on Public Health, Hospitals, and Charities. January 3, 1936. 4 pages.

1746. Studies of sewage purification. IV. The use of chlorine for the correction of sludge bulking in the activated sludge process. By Russell S. Smith and W. C. Purdy. May 15, 1936. 7 pages.

1751. Application of the preliminary sanitary survey to flooded areas. By J. M. Dalla Valle and J. J. Bloomfield. May 29, 1936. 6 pages.

1752. Rat-proof construction and its effect on the control of rat life on ships. Instances of permanent and apparent automatic control effected by this type of construction observed on 50 ships at the port of New York. By B. E. Holsendorf. May 29, 1936. 13 pages.

Screenings Shredder:

A "triturator" has been announced by Chain Belt Co., Milwaukee, Wisc., which is described in an 8-page catalog. This triturator is designed for shredding sewage screenings, through the action of 350,000 blade cuts per minute. Considerable information, and illustrations showing installation details, power and water required, are given. Catalog sent on request to above address.

Steel Swimming Pools:

A 4-page bulletin that will acquaint you with the various factors of importance in connection with all-steel swimming pools. No design data, but some interesting information nevertheless. Write Pittsburgh Des Moines Steel Co., 3423 Neville Island, Pittsburgh, Pa.

Proportioning:

D. W. Haering & Co., Inc., 3408 W. Monroe St., Chicago, Ill., announce a 24-page bulletin on "The Art of Proportioning." We have no copy but quote from the announcement: "The use of pitot tubes, fluid pistons and proportioning of various chemicals is discussed in detail." Sent on request.

A R B A Convention Proceedings:

This volume, of 992 pages, contains the papers presented at the A R B A meetings for 1935 in Washington and for 1936 at Cleveland. The papers are given in full and cover a wide range of important topics, from "Adequate Design" to "W P A and Farm to Market Roads." The price is $10 from American Road Builders Assn., National Press Bldg., Washington, D. C.

Roadsides—The Front Yard of the Nation:

J. M. Bennett has written a text to explain how and why roadside development should be practiced. It is nontechnical in nature, and designed to excite a permanent interest in the uses of trees, shrubs and other plants; to emphasize how natural surroundings can be developed; to present and explain the problems involved; and to show how everyone can support such a problem. Excellent bibliography. 18 ills.; 228 pp. $3. Published by Stratford Co., Boston.

DISTRIBUTORS WANTED — to handle a complete line of roadside and portable stone crushers for town, county and city use. Box 4G, PUBLIC WORKS Magazine, 310 East 45th St., New York, N. Y.

HELP WANTED

Wanted young ambitious sanitary engineer—age 25 to 30—for new development in sewage field; write stating experience, qualifications, salary; Box 3, c/o PUBLIC WORKS magazine, 310 East 45th St., New York, N. Y.

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